DICTIONARY OF MEDICINE

R. QUAIN, M.D.

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DICTIONARY OF MEDICINE

VOL. I.

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A

DICTIONARY OF MEDICINE

INCLUDING GENERAL PATHOLOGY, GENERAL THERAPEUTICS
HYGIENE AND THE DISEASES OF WOMEN AND CHILDREN

BY VARIOUS WRITERS

EDITED BY

RICHARD QUAIN, BART., M.D.LOND., LL.D.ED., F.R.S.

President of the General Council of Medical Education: Member of the Senate of the University of London
Hon. M.D. Trin. Coll. Dublin: Hon. M.D. Royal University of Ireland
Fellow, late Vice-President and Senior Censor of the Royal College of Physicians
Hon. Fellow of the Royal College of Physicians of Ireland

Physician Extraordinary to Her Majesty the Queen

Consulting Physician to the Hospital for Diseases of the Chest, Brompton
and to the Seamen's Hospital, Greenwich

ASSISTED BY

FREDERICK THOMAS ROBERTS, M.D.LOND., B.SC.

Fellow of the Royal College of Physicians: Fellow of University College
Professor of Materia Medica and Therapeutics, University College
Physician and Professor of Clinical Medicine, University College Hospital
Consulting Physician to the Hospital for Consumption and Diseases of the Chest, Brompton

AND

J. MITCHELL BRUCE, M.A.ABDN., M.D.LOND.

Fellow of the Royal College of Physicians
Physician and Lecturer on the Principles and Practice of Medicine, Charing Cross Hospital
Physician to the Hospital for Consumption and Diseases of the Chest, Brompton

NEW EDITION, REVISED THROUGHOUT AND ENLARGED.

DIVISION I.

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1894

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PREFACE

1894

The Preface to the original issue of this Dictionary, which will be found at page vii of the present volume, contains a statement of the motive which originally induced the Editor to enter on the preparation of the work. Briefly, that motive was supplied by a desire to place in the hands of the practitioner, the teacher, and the student, a means of ready reference to the accumulated knowledge which we possessed of scientific and practical Medicine, rapid as was its progress, and difficult of access as were its scattered records.

That the object in view was successfully attained, has been rendered abundantly evident by the reception accorded to the Dictionary. Since its appearance in 1882 more than 33,000 copies have been issued in this country and America, whilst the Editor personally has received most gratifying assurances of the value and utility of the work.

Having made this reference to the past, he has now to say that the motive which then influenced him is felt with greatly increased force at the present time. Never in the history of Medicine has progress been so rapid as during the last twelve years. Not only has our knowledge of old and familiar facts been improved, but an entirely new development of our science has occurred, more especially with reference to the causation of disease and, it may be added, the preservation of health. It had therefore become necessary to make a complete revision of the work. In the performance of this duty, it has been the aim of the Editor to combine what was good in the original, amended as experience suggested, with such new matter as proved to be acceptable after full consideration.

In order to accomplish these objects, the several articles have been revised by the original writers, so far as this has been practicable. When death unhappily prevented such revision, the task was committed to other not less competent writers. The services of equally competent contributors were secured for the preparation of new articles. To these gentlemen, friends and colleagues, the Editor offers his grateful thanks for the ability and zeal with which they have discharged the duties undertaken by them. He has the gratification of feeling that the contributors to the Dictionary may regard with great satisfaction the result of their labours.

The Editor has also to speak with sincere thanks of the valuable services which have been rendered him by his fellow-labourers, Dr. Frederick T. Roberts and Dr. J. Mitchell Bruce. In the Preface to the former Edition he stated that without the help afforded by them he would have found it impossible to accomplish the undertaking. He appreciated then the marked ability by which their assistance had been characterised, and he desires now to repeat the expression of his appreciation, recognising that their services have been rendered of much greater value by their increased experience. He has on these grounds felt it a pleasing duty to place the names of these gentlemen on the title-page as his Assistant-Editors. At the same time he feels it right to say that he is personally responsible for the work, of which no portion has been issued without being carefully revised by him. He has also heartily to thank his friend Mr. John Harold, Medical Registrar to Charing Cross Hospital, not only for his contributions to the Dictionary, and for the assistance which he has rendered in revising the proof-sheets and passing the work through the press, but also for the pains which he has bestowed upon the conduct of the necessary correspondence with various writers, and in collecting the materials.

It only remains to state that the work, consisting now of two volumes, has been entirely reprinted in larger type, that the number of pages has been increased from 1,834 to 2,518, and that 43 new illustrations have been added to those in the former Edition, so that the illustrations now amount to 181.

London: *May* 1894.

PREFACE

1882

The vast number of facts and observations, by which the recent progress of scientific and practical medicine has been marked, is diffusely recorded in the Transactions of learned societies, in journals, in monographs, and in systematic treatises. With progress so rapid, and information so diffused, it is extremely difficult alike for the practitioner, the teacher, and the student to keep pace. It was the perception of this difficulty which induced the Editor, when invited to undertake the production of a new Medical Dictionary, to engage in a task which, he was fully conscious, must be one of great labour and of great responsibility. He felt, however, that he would be rendering useful service to his Profession if he could bring together the latest and most complete information in a form which would allow of ready and easy reference. Accordingly, he invited the co-operation of certain of his colleagues and professional friends, both in this country and abroad; and evidence of the readiness with which this invitation has been accepted, is afforded by the list of contributors. Each contributor volunteered or was invited to write on a subject with which he was specially familiar. The present work, which is the result of these combined efforts, may therefore be regarded not only as a dictionary, but also as a treatise on systematic medicine, in which the articles on the more important subjects constitute monographs in themselves, whilst definitions and descriptions of matters having less claim to extended notice are given as fully as is required. Thus an endeavour has been made to supply, in a clear, condensed, and readily accessible form, all the information that is at present available for the use of the practitioner of medicine.

As indicated on the title-page, the work is primarily a dictionary of Medicine, in which the several diseases are fully discussed in alphabetical order. The description of each includes an account of its ætiology and anatomical characters; its symptoms, course, duration, and terminations; its diagnosis, prognosis, and, lastly, its treatment. General Pathology comprehends articles on the origin, characters, and nature of disease, and the many considerations which these topics suggest. General Therapeutics will be found to include articles on the several classes of remedies—medicinal or otherwise—which are available for the purpose of treatment; on the modes of action of such remedies; and on the methods of their use. The articles devoted to the subject of Hygiene will be found to treat of the causes of disease, of its prevention, of the agencies and laws affecting public health, of the means of preserving the health of the individual, of the construction and management of hospitals, and of the nursing the sick. Lastly, the diseases peculiar to Women and Children are discussed under their respective headings, both in aggregate and in detail.

It may be well to explain that, although it has been found necessary to include some notice of diseases which fall more generally under the care of the surgeon, the work does not pretend to be a dictionary of Surgery; and also that, although certain drugs are enumerated in discussing subjects of general therapeutics, and of poisons and their actions, there has been no intention to invade the domain of Materia Medica.

It is right to observe that all the articles have been edited and revised with great care, so as to ensure a completeness and unity in the work, which it is not always possible to obtain in books composed by a number of writers.

The Editor desires also to state that, although the work has occupied several years in preparation, arrangements were made with the printers which have enabled him to revise every article which required revision, up to the time of going to press. Further, by the addition of an Appendix, it has been possible to incorporate the latest contributions to medical knowledge.

Having thus set forth the aims and objects of his undertaking, and how far they have been carried out, the Editor has the great satisfaction of offering his thanks to his friends and colleagues, for the valuable assistance which he has received from them. He is fully conscious of the trouble which must often have been necessary in order to condense extended knowledge of a familiar subject within the limited space which the nature of this work could afford.

The Editor has further the pleasing duty of offering his special thanks to Dr. FREDERICK T. ROBERTS and to Dr. J. MITCHELL BRUCE, who from the first have been his Assistant-Editors and fellow-labourers. Without the help which they have afforded him, it would have been impossible for him to have fulfilled the duties which he undertook. He is well aware of the time and labour which their assistance has involved; and he appreciates most fully the marked ability by which it has been characterised.

The Editor cannot conclude without a reference to some of those who were his friends and colleagues when this work was commenced, but who have since been taken away by death. He would specially mention the names of Edmund Parkes, Charles Murchison, George Callender, Thomas Bevill Peacock, John Rose Cormack, Lockhart Clarke, Tilbury Fox, Thomas Hayden, Harry Leach, Alexander Silver. The loss of these eminent men, many of them dear and valued friends, and all of them taken too soon from their unfinished labours, is to him a source of personal sorrow. The articles written by them for these pages were in most instances their last contributions to medical literature, and will be valued accordingly.

London: *September* 1882.

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LIST OF CONTRIBUTORS

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ADAMS, WILLIAM, Consulting Surgeon to the Great Northern Central Hospital.

AITKEN, The late SIR WILLIAM, M.D., LL.D., F.R.S., Professor of Pathology in the Army Medical School, Netley.

ALLBUTT, T. CLIFFORD, M.A., M.D., LL.D., F.R.S., Regius Professor of Physic in the University of Cambridge; Consulting Physician to the Leeds General Infirmary.

ALLCHIN, WILLIAM H., M.D., F.R.S.E., Physician to, and late Joint Lecturer on the Principles and Practice of Medicine at, the Westminster Hospital; late Physician to the Victoria Hospital for Children.

ANDREW, JAMES, M.D., late Physician to, and Joint Lecturer on Physic at, St. Bartholomew's Hospital; Consulting Physician to the City of London Hospital for Diseases of the Chest.

BALFOUR, GEORGE W., M.D., F.R.S.E., Consulting Physician to the Royal Infirmary, and to the Royal Hospital for Children, Edinburgh.

BANHAM, G. A., late Veterinary Assistant at the Brown Institution.

BARNES, ROBERT, M.D., Consulting Obstetric Physician to, and late Lecturer on Midwifery and Diseases of Women at, St. George's Hospital; Consulting Physician to the Seamen's Hospital, and to the Royal Maternity Charity.

BASTIAN, H. CHARLTON, M.A., M.D., F.R.S., Physician to University College Hospital, Professor of the Principles and Practice of Medicine and of Clinical Medicine, and late Professor of Pathological Anatomy, at University College; Physician to the National Hospital for the Paralysed and Epileptic.

BÄUMLER, C. G. H., M.D., Professor of Clinical Medicine, and Director of the Medical Clinic, University of Freiburg in Baden.

BECK, The late MARCUS, M.B., M.S., Surgeon to University College Hospital, and Professor of Surgery at University College.

BEDDOE, JOHN, B.A., M.D., F.R.S., late Physician to the Bristol Royal Infirmary.

BELLAMY, The late EDWARD, Surgeon to, and Lecturer on Surgery at, the Charing Cross Hospital.

BENNET, The late J. HENRY, M.D., formerly Physician-Accoucheur, Royal Free Hospital.

BENNETT, The late SIR J. RISDON, M.D., LL.D., F.R.S., President of the Royal College of Physicians; Consulting Physician to St. Thomas's Hospital, and to the City of London Hospital for Diseases of the Chest.

BEVERIDGE, The late ROBERT, M.B., Physician to, and Lecturer on Clinical Medicine at, the Aberdeen Royal Infirmary.

BINZ, CARL, M.D., Professor of Pharmacology in the University of Bonn.

BIRKETT, JOHN, Consulting Surgeon to Guy's Hospital.

BISHOP, The late JOHN, M.D., C.M., Assistant Surgeon to the Royal Infirmary, Edinburgh.

BLANDFORD, GEORGE F., M.A., M.D., Lecturer on Psychological Medicine at St. George's Hospital.

BOWLES, R. LEAMON, M.D., Consulting Physician to the Folkestone Hospital.

BRISTOWE, J. SYER, M.D., LL.D., F.R.S., Consulting Physician to, and late Joint Lecturer on Medicine at, St. Thomas's Hospital.

BROADBENT, SIR WILLIAM H., Bart., M.D., Physician to H.R.H. the Prince of Wales; Physician to, and Lecturer on Clinical Medicine at, St. Mary's Hospital; Consulting Physician to the London Fever Hospital.

BROWN-SÉQUARD, The late C. E., M D., LL.D., F.R.S., Professor of Medicine, Collège de France.

BRUCE, J. MITCHELL, M.A., M.D., Physician to, and Lecturer on the Principles and Practice of Medicine at, the Charing Cross Hospital; Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

BRUCE, WILLIAM, M.A., LL.D., M.D., Senior Surgeon to the Ross Memorial Hospital, Dingwall.

BRUNTON, T. LAUDER, M.D., LL.D., D.Sc., F.R.S., Assistant Physician to, and Lecturer on Materia Medica and Therapeutics at, St. Bartholomew's Hospital.

BUCHANAN, SIR GEORGE, B.A., LL.D., M.D., F.R.S., late Medical Officer of H.M. Local Government Board; Consulting Physician to the London Fever Hospital.

BUTLIN, H. TRENTHAM, D.C.L., Surgeon to St. Bartholomew's Hospital.

BUZZARD, THOMAS, M.D., Physician to the National Hospital for the Paralysed and Epileptic.

CADGE, WILLIAM, Surgeon to the Norfolk and Norwich Hospital.

CALLENDER, The late G. W., F.R.S., Surgeon to, and Lecturer on Surgery at, St. Bartholomew's Hospital.

CANTLIE, JAMES, M.A., M.B., C.M., late Senior Assistant Surgeon to, and Demonstrator of Anatomy at, the Charing Cross Hospital.

CARPENTER, The late W. B., C.B., M.D., LL.D., F.R.S.

CARTER, R. BRUDENELL, Consulting Ophthalmic Surgeon to, and late Lecturer on Ophthalmic Surgery at, St. George's Hospital.

CAYLEY, WILLIAM, M.D., Physician to, and Lecturer on Medicine at, the Middlesex Hospital; Consulting Physician to the London Fever Hospital.

CLARKE, The late J. LOCKHART, M.D., F.R.S., Physician to the Hospital for Epilepsy and Paralysis.

CLARKE, The late W. FAIRLIE, M.A., M.D., Assistant Surgeon to the Charing Cross Hospital.

CLOVER, The late J. T., Lecturer on Anæsthetics at University College Hospital.

COBBOLD, CHARLES S. W., M.D., late Medical Superintendent, Asylum for Idiots, Earlswood; late Senior Assistant Medical Officer, Middlesex County Asylum, Colney Hatch.

COBBOLD, The late T. SPENCER, M.D., F.R.S.

COLLIE, ALEXANDER, M.D., late Medical Officer, Fever Hospital, Homerton.

COOPER, ARTHUR, Surgeon to the Westminster General Dispensary; late House Surgeon to the Male Lock Hospital.

CORMACK, The late SIR JOHN ROSE, K.C.B., M.D., F.R.S.E., Physician to the Hertford British Hospital, Paris.

CUNNINGHAM, D. DOUGLAS, C.I.E., M.B., C.M., Brigade Surgeon-Lieutenant-Colonel H.M. Bengal Army.

CURLING, The late T. B., F.R.S., Consulting Surgeon to the London Hospital.

CURNOW, JOHN, M.D., Physician to King's College Hospital; Professor of Anatomy in King's College; Senior Visiting Physician to the Seamen's Hospital, Greenwich.

DALBY, SIR WILLIAM B., B.A., M.B., Consulting Aural Surgeon to, and late Lecturer on Aural Surgery at, St. George's Hospital.

DAVIDSON, ALEXANDER, M.A., M.D., Physician to the Royal Infirmary, Liverpool, and Emeritus Professor of Pathology in University College, Liverpool.

DE ZOUCHE, ISAIAH, M.D., Honorary Physician to the Dunedin Hospital, New Zealand.

DUNCAN, The late J. MATTHEWS, M.A., M.D., LL.D., F.R.S.E., Physician-Accoucheur to, and Lecturer on Midwifery at, St. Bartholomew's Hospital.

DURHAM, ARTHUR E., late Senior Surgeon to, and Lecturer on Surgery at, Guy's Hospital.

ECHEVERRIA, M. G., M.D., late Physician-in-Chief to the Hospital for Epileptics and Paralytics, and to the City Asylum for the Insane, New York.

EWART, JOSEPH, M.D., Retired Deputy Surgeon-General H.M. Bengal Army; late Professor of Medicine, Principal, and Senior Physician, Calcutta Medical College.

EWART, WILLIAM, B.A., M.D., Physician to St. George's Hospital; late Assistant Physician and Pathologist to the Hospital for Consumption and Diseases of the Chest, Brompton.

FARQUHARSON, ROBERT, M.D., M.P., late Physician to the Belgrave Hospital for Children; late Assistant Physician to, and Lecturer on Materia Medica at, St. Mary's Hospital.

FAYRER, SIR JOSEPH, K.C.S.I., M.D., LL.D., F.R.S., Honorary Physician to H.M. the Queen, and to H.R.H. the Prince of Wales; President of the Medical Board, India Office; Consulting Physician to the Charing Cross Hospital.

FENWICK, SAMUEL, M.D., Physician to, and late Lecturer on Medicine at, the London Hospital; late Assistant Physician to the City of London Hospital for Diseases of the Chest.

FERRIER, DAVID, M.A., M.D., LL.D., F.R.S., Physician to King's College Hospital; Physician to the National Hospital for the Paralysed and Epileptic; Professor of Neuropathology in King's College.

FINNEY, J. MAGEE, B.A., M.D., Physician to the City of Dublin Hospital; King's Professor of the Practice of Medicine at the School of Physic in Ireland, and Professor of Clinical Medicine in Sir Patrick Dun's Hospital.

FOSTER, SIR WALTER, M.D., D.C.L., M.P., Consulting Physician to the General Hospital, and Emeritus Professor of the Principles and Practice of Physic in Queen's College, Birmingham.

FOX, E. LONG, M.D., Consulting Physician to the Bristol Royal Infirmary, and late Lecturer on the Principles and Practice of Medicine at the Bristol School of Medicine.

FOX, T. COLCOTT, B.A., M.B., Physician for Diseases of the Skin, Westminster Hospital; late Physician to the Victoria Hospital for Children.

FOX, The late TILBURY, M.D., Physician to the Skin Department, University College Hospital.

GALTON, SIR DOUGLAS, Late Royal Engineers, K.C.B., D.C.L., F.R.S.

GASCOYEN, The late GEORGE G., Surgeon to the Lock Hospital; Assistant Surgeon to, and Lecturer on Surgery at, St. Mary's Hospital.

GEE, SAMUEL JONES, M.D., Physician to St. Bartholomew's Hospital; Consulting Physician to the Hospital for Sick Children, Great Ormond Street.

GODLEE, RICKMAN J., B.A., M.B., M.S., Surgeon to, and Professor of Clinical Surgery at, University College Hospital; Surgeon to the Hospital for Consumption and Diseases of the Chest, Brompton; Consulting Surgeon to the North-East Hospital for Children.

GODSON, CLEMENT, M.D., Consulting Physician to the City of London Lying-in Hospital; late Assistant Physician-Accoucheur to St. Bartholomew's Hospital.

GOWERS, WILLIAM R., M.D., F.R.S., Consulting Physician to, and late Professor of Clinical Medicine at, University College Hospital; Physician to the National Hospital for the Paralysed and Epileptic.

GREEN, T. HENRY, M.D., Physician to, Special Lecturer on Clinical Medicine and late Lecturer on Pathology at, the Charing Cross Hospital; Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

GREENFIELD, WILLIAM S., M.D., Professor of General Pathology and Clinical Medicine in the University of Edinburgh.

GRIMSHAW, THOMAS W., M.A., M.D., Registrar-General for Ireland; Consulting Physician to the Fever Hospital, Cork Street, and to Steeven's Hospital, Dublin.

HAWARD, J. WARRINGTON, Surgeon to St. George's Hospital; late Assistant Surgeon to the Hospital for Sick Children, Great Ormond Street.

HAYDEN, The late THOMAS, M.D., Physician to the Mater Misericordiæ Hospital, Dublin; Professor of Anatomy and Physiology, Catholic University, Dublin.

HERMAN, G. ERNEST, M.B., Obstetric Physician to, and Lecturer on Midwifery at, the London Hospital; Physician to the Royal Maternity Charity.

HICKS, J. BRAXTON, M.D., F.R.S., late Physician-Accoucheur to, and Lecturer on Midwifery and Diseases of Women and Children at, Guy's Hospital.

HILL, The late BERKELEY, M.B., Surgeon to, and Professor of Clinical Surgery at, University College Hospital; Surgeon to the Lock Hospital.

HOLMES, TIMOTHY, M.A., Consulting Surgeon to, and late Lecturer on Surgery at, St. George's Hospital.

HORSLEY, VICTOR A. H., M.B., B.S., F.R.S., Professor of Pathology in University College; Surgeon to University College Hospital, and to the National Hospital for the Paralysed and Epileptic.

HOWARD, BENJAMIN, M.D., late Professor of Medicine, and Lecturer on Medicine, in the University of New York.

HUTCHINSON, JONATHAN, LL.D., F.R.S., late President of the Royal College of Surgeons; Consulting Surgeon to the London Hospital, to the Hospital for Diseases of the Skin, Blackfriars, and to the Royal London Ophthalmic Hospital.

IRVINE, The late J. PEARSON, B.A., B.Sc., M.D., Assistant Physician to, and Lecturer on Forensic Medicine at, the Charing Cross Hospital; Physician to the Victoria Hospital for Children.

JENNER, SIR WILLIAM, Bart., G.C.B., M.D., D.C.L., LL.D., F.R.S., Physician-in-Ordinary to H.M. the Queen, and to H.R.H. the Prince of Wales; late President of the Royal College of Physicians; Consulting Physician to University College Hospital.

JONES, JOSEPH, M.D., Professor of Chemistry and Clinical Medicine, New Orleans, and President of the Board of Health, State of Louisiana, New Orleans.

LANGDON-DOWN, JOHN, M.D., Consulting Physician to, and late Lecturer on Clinical Medicine at, the London Hospital.

LATHAM, PETER W., A.M., M.D., Senior Physician to Addenbrooke's Hospital; late Downing Professor of Medicine in the University of Cambridge.

LEACH, The late HARRY, Medical Officer of Health for the Port of London, and Physician to the Seamen's Hospital, Greenwich.

LEGG, J. WICKHAM, M.D., late Assistant Physician to, and Lecturer on Pathological Anatomy at, St. Bartholomew's Hospital.

LEWIS, The late TIMOTHY, M.D., F.R.S. (Elect), Surgeon-Major H.M. Army.

LITTLE, JAMES, M.D., Physician to the Adelaide Hospital, Dublin; late Professor of Practice of Medicine in the Royal College of Surgeons in Ireland; Consulting Physician to the Rotunda Lying-in Hospital.

LIVEING, ROBERT, M.A., M.D., late Physician for Diseases of the Skin, and Lecturer on Diseases of the Skin, at the Middlesex Hospital.

McCARTHY, JEREMIAH, M.A., M.B., Surgeon to, and late Lecturer on Surgery at, the London Hospital.

MAC CORMAC, SIR WILLIAM, M.A., M.Ch., Consulting Surgeon to, and late Lecturer on Surgery at, St. Thomas's Hospital.

McKENDRICK, J. GRAY, M.D., F.R.S., Professor of the Institutes of Medicine in the University of Glasgow.

MACKENZIE, STEPHEN, M.D., Physician to, and Lecturer on the Principles and Practice of Medicine at, the London Hospital.

MACLEAN, Surgeon-General W. CAMPBELL, C.B., M.D., Inspector-General of Hospitals; late Professor of Military Medicine in the Army Medical School, Netley.

MACNAMARA, CHARLES NOTTIDGE, Surgeon to the Westminster Hospital; Consulting Surgeon to the Royal Westminster Ophthalmic Hospital.

MACPHERSON, The late JOHN, M.A., M.D., Inspector-General of Hospitals, H.M. Bengal Army.

MADDEN, T. MORE, M.D., Obstetric Physician to the Mater Misericordiæ Hospital, Dublin.

MANSON, PATRICK, M.D., LL.D., Physician to the Seamen's Hospital, Greenwich; late Lecturer on Medicine in the College of Medicine for the Chinese, Hong Kong.

MEREDITH, W. APPLETON, M.B., C.M., Surgeon to the Samaritan Free Hospital for Women and Children.

MERYON, The late EDWARD, M.D., Physician to the Hospital for Epilepsy and Paralysis.

MUIRHEAD, CLAUD, M.D., Consulting Physician to, and formerly Lecturer on Clinical Medicine at, the Royal Infirmary, Edinburgh.

MURCHISON, The late CHARLES, M.D., LL.D., F.R.S., Physician to, and Special Professor of Clinical Medicine at, St. Thomas's Hospital; Consulting Physician to the London Fever Hospital.

MYERS, ARTHUR B. R., late Brigade-Surgeon, Brigade of Guards.

NETTLESHIP, EDWARD, Ophthalmic Surgeon to St. Thomas's Hospital, and to the Royal London Ophthalmic Hospital; late Ophthalmic Surgeon to the Hospital for Sick Children, Great Ormond Street.

NIGHTINGALE, FLORENCE.

OLIVER, GEORGE, M.D., Harrogate.

ORD, W. MILLER, M.D., Physician to, and Lecturer on Medicine at, St. Thomas's Hospital.

PAGET, SIR JAMES, Bart., D.C.L., LL.D., F.R.S., Sergeant-Surgeon to H.M. the Queen; Surgeon to H.R.H. the Prince of Wales; Consulting Surgeon to St. Bartholomew's Hospital.

PARKES, The late EDMUND A., M.D., F.R.S., Professor of Hygiene in the Army Medical School, Netley.

PAVY, FREDERICK W., M.D., LL.D., F.R.S., Consulting Physician to, and late Lecturer on Medicine at, Guy's Hospital.

PAYNE, J. FRANK, B.A., B.Sc., M.D., Physician to, and Lecturer on Medicine at, St. Thomas's Hospital.

PEACOCK, The late T. BEVILL, M.D., Honorary Consulting Physician to St. Thomas's Hospital; and Consulting Physician to the City of London Hospital for Diseases of the Chest.

PLAYFAIR, WILLIAM S., M.D., LL.D., Physician-Accoucheur to H.I. and R.H. the Duchess of Edinburgh; Physician for Diseases of Women and Children to King's College Hospital, and Consulting Physician to the General Lying-in Hospital; Professor of Obstetric Medicine in King's College.

POORE, G. VIVIAN, M.D., Physician to, and Professor of Clinical Medicine at, University College Hospital; Professor of Medical Jurisprudence at University College.

POWELL, R. DOUGLAS, M.D., Physician Extraordinary to H.M. the Queen; Physician to the Middlesex Hospital, and Consulting Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

QUAIN, SIR RICHARD, Bart., M.D., LL.D., F.R.S., Physician Extraordinary to H.M. the Queen; Consulting Physician to the Hospital for Consumption and Diseases of the Chest, Brompton, and to the Seamen's Hospital, Greenwich.

RADCLIFFE, The late J. NETTEN, Assistant Medical Officer, Local Government Board.

RALFE, CHARLES H., M.A., M.D., Physician to the London Hospital; late Physician to the Seamen's Hospital, Greenwich.

REDWOOD, The late RALFE THEOPHILUS, Ph.D., Professor of Chemistry and Pharmacy, Pharmaceutical Society of Great Britain.

ROBERTS, FREDERICK T., M.D., B.Sc., Physician to, and Professor of Clinical Medicine at, University College Hospital; Professor of Materia Medica at University College; Consulting Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

ROBERTS, SIR WILLIAM, B.A., M.D., F.R.S., late Physician to the Manchester Royal Infirmary; late Professor of Medicine in the Victoria University.

ROSE, WILLIAM, M.B., B.S., Surgeon to King's College Hospital; Professor of Clinical Surgery, King's College; Consulting Surgeon to the Royal Free Hospital.

ROY, CHARLES S., M.A., M.D., F.R.S., Professor of Pathology, University of Cambridge; late Professor Superintendent of the Brown Institution, London.

RUSSELL, The Right Hon. JAMES A., M.A., M.B., C.M., Inspector of Anatomy for Scotland; late Lecturer on Sanitation, Watt's Institution, Edinburgh.

SALTER, S. J., M.B., F.R.S., F.L.S., late Dental Surgeon to Guy's Hospital.

SANGSTER, ALFRED, B.A., M.B., Physician for Diseases of the Skin to, and Lecturer on Skin Diseases at, the Charing Cross Hospital.

SAUNDBY, ROBERT, M.D., Physician to the General Hospital, and Professor of Medicine in Mason College, Birmingham.

SCHÄFER, EDWARD ALBERT, F.R.S., Jodrell Professor of Physiology in University College.

SEATON, The late EDWARD C., M.D., Medical Officer to the Local Government Board.

SHAPTER, THOMAS, M.D., LL.D., Consulting Physician to the Devon and Exeter Hospital.

SIBBALD, JOHN, M.D., F.R.S.E., Commissioner in Lunacy for Scotland.

SILVER, The late ALEXANDER, M.A., M.D., Physician to, and Lecturer on Physiology at, the Charing Cross Hospital.

SIMON, SIR JOHN, C.B., D.C.L., LL.D., F.R.S., Consulting Surgeon to St. Thomas's Hospital; late Medical Officer to Her Majesty's Privy Council, and to the Local Government Board.

SIMPSON, ALEXANDER RUSSELL, M.D., Physician to the University Clinical Ward for Diseases of Women, Royal Infirmary, Edinburgh; Professor of Midwifery and Diseases of Women and Children in the University of Edinburgh.

SMITH, EUSTACE, M.D., Physician to H.M. the King of the Belgians; Physician to the City of London Hospital for Diseases of the Chest, and to the East London Hospital for Children.

SMITH, W. JOHNSON, Surgeon to the Seamen's Hospital, Greenwich.

SOUTHEY, REGINALD, M.D., Commissioner in Lunacy; late Physician to, and Lecturer on Forensic Medicine and Hygiene at, St. Bartholomew's Hospital.

SPARKS, The late EDWARD I., M.A., M.B., Physician for Diseases of the Skin to the Charing Cross Hospital, and Physician to the Royal Infirmary for Women and Children.

SQUIRE, WILLIAM, M.D., Physician to the St. George's Dispensary, and late Physician to the North London Hospital for Diseases of the Chest.

STEVENSON, THOMAS, M.D., Lecturer on Chemistry and Medical Jurisprudence at Guy's Hospital; Scientific Analyst to the Home Office.

STEWART, T. GRAINGER, M.D., F.R.S.E., Physician in Ordinary to H.M. the Queen for Scotland; Professor of Practice of Physic and of Clinical Medicine in the University of Edinburgh.

STREATFEILD, The late J. F., Surgeon to the Royal London Ophthalmic Hospital; Professor of Clinical Ophthalmic Surgery at, and Ophthalmic Surgeon to, University College Hospital.

THIN, GEORGE, M.D., London.

THOMPSON, E. SYMES, M.D., Consulting Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

THOMPSON, SIR HENRY, Surgeon Extraordinary to H.M. the King of the Belgians; Consulting Surgeon to University College Hospital; Emeritus Professor of Clinical Surgery at University College.

THORNTON, W. PUGIN, late Surgeon to the St. Marylebone General Dispensary.

THOROWGOOD, JOHN C., M.D., Physician to the City of London Hospital for Diseases of the Chest, and to the West London Hospital; late Lecturer on Materia Medica at the Middlesex Hospital.

TUKE, J. BATTY, M.D., F.R.S.E., formerly Lecturer on Mental Diseases at the Royal College of Surgeons, Edinburgh.

WALKER, THOMAS J., M.D., Surgeon to the Peterborough Infirmary and Dispensary.

WARD, The late STEPHEN H., M.D., Consulting Physician to the Seamen's Hospital, Greenwich; and Physician to the City of London Hospital for Diseases of the Chest.

WARDELL, The late J. R., M.D., Consulting Physician to the Tunbridge Wells Infirmary.

WATERS, A. T. H., M.D., Consulting Physician to the Royal Infirmary, Liverpool; late Professor of the Principles and Practice of Medicine in University College, Liverpool.

WEBER, HERMANN, M.D., Consulting Physician to the German Hospital.

WELLS, SIR T. SPENCER, Bart., late President of the Royal College of Surgeons; Surgeon to the Queen's Household; Consulting Surgeon to the Samaritan Hospital for Women and Children.

WILLIAMS, C. THEODORE, M.A., M.D., Senior Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

WILLIAMS, JOHN, M.D., Consulting Obstetric Physician, University College Hospital.

WILSON, The late SIR ERASMUS, LL.D., F.R.S., President of the Royal College of Surgeons; Professor of Dermatology, Royal College of Surgeons.

WILTSHIRE, The late ALFRED, M.D., Physician-Accoucheur to, and Joint Lecturer on Obstetric Medicine at, St. Mary's Hospital; Physician for Diseases of Women to the West London Hospital.

WOOD, The late JOHN, F.R.S., Surgeon to King's College Hospital, and Professor of Clinical Surgery in King's College.

ADDITIONAL CONTRIBUTORS

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ACKLAND, ROBERT CRAIG, Assistant Dental Surgeon to St. Bartholomew's Hospital.

BAILEY, G. HEWLETT, Chloroformist to the Dental Hospital of London.

BAKER, W. MORRANT, late Surgeon to St. Bartholomew's Hospital.

BALL, JAMES BARRY, M.D., Assistant Physician, and Physician to the Department for Diseases of the Throat and Nose, to the West London Hospital.

BANKS, SIR JOHN, K.C.B., M.D., D.Sc., LL.D., Physician in Ordinary to H.M. the Queen in Ireland; Regius Professor of Physic in the University of Dublin; Consulting Physician to Sir Patrick Dun's Hospital.

BOWLBY, ANTHONY A., Assistant Surgeon, and Surgeon in Charge of the Throat Department, to St. Bartholomew's Hospital.

BOYD, STANLEY, M.B., B.S., Surgeon to, and Lecturer on Anatomy at, the Charing Cross Hospital; Surgeon to the Paddington Green Children's Hospital.

BRUCE, DAVID, M.B., C.M., Surgeon-Captain, H.M. Army.

CASSON, WILLIAM A., Barrister-at-Law, Local Government Board.

CHARTERIS, MATTHEW, M.D., Professor of Materia Medica and Therapeutics in the University of Glasgow.

CRAIGIE, J. HAMILTON, Surgeon Dentist to the Chelsea Hospital for Women.

CROCKER, H. RADCLIFFE, M.D., Physician to the Skin Department, University College Hospital.

CURRIE, ANDREW STARK, M.D., late Assistant to the Professor of Physiology in the University of Glasgow.

FENWICK, W. SOLTAU, M.D., B.S., Physician for Out-Patients to the Evelina Hospital for Sick Children.

GERVIS, HENRY, M.D., Consulting Obstetric Physician to St. Thomas's Hospital.

GOODHART, JAMES F., M.D., Physician to, and late Lecturer on Pathology at, Guy's Hospital; Consulting Physician to the Evelina Hospital for Sick Children.

HAROLD, JOHN, Medical Registrar to the Charing Cross Hospital.

HEBB, RICHARD GRAINGER, M.A., M.D., Assistant Physician and Pathologist to, and Lecturer on Pathology and Morbid Anatomy at, the Westminster Hospital.

JACOBSON, WALTER H. A., M.A., M.B., M.Ch., Assistant Surgeon to, and Lecturer on Anatomy at, Guy's Hospital.

KIDD, PERCY, M.A., M.D., Assistant Physician and Pathologist to the London Hospital; Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

LITTLE, JOHN FLETCHER, M.B., Physician to the North London Hospital for Consumption.

LUFF, ARTHUR PEARSON, M.D., B.Sc., Physician for Out-Patients to, and Lecturer on Medical Jurisprudence at, St. Mary's Hospital; Official Analyst to the Home Office.

McKEE, ALEXANDER BAILLIE, B.A., M.B., B.Ch., late Curator of the Museum, Royal College of Surgeons, Ireland.

MAC MUNN, CHARLES A., M.A., M.D., Pathologist to the Wolverhampton and Staffordshire General Hospital.

MAGUIRE, ROBERT, M.D., Physician for Out-Patients to, and Joint Lecturer on Pathology at, St. Mary's Hospital; Assistant Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

MAPOTHER, E. DILLON, M.D., late President of the Royal College of Surgeons of Ireland.

MARTIN, SIDNEY H. C., M.D., B.Sc., Assistant Physician to University College Hospital, and to the Hospital for Consumption and Diseases of the Chest, Brompton.

MORGAN, The late JOHN EDWARD, M.A., M.D., Consulting Physician to the Manchester Royal Infirmary, and Professor of Medicine in the Victoria University.

MOTT, FREDERICK W., M.D., B.S., Assistant Physician to, and Lecturer on Physiology at, the Charing Cross Hospital.

MUIR, ROBERT, M.D., C.M., Senior Demonstrator of Pathology in the University of Edinburgh.

MURPHY, J. SHIRLEY FORSTER, Medical Officer of Health of the Administrative County of London.

MURRAY, H. MONTAGUE, M.D., Physician for Out-Patients to the Charing Cross Hospital, and to the Victoria Hospital for Children. Lecturer on Pathology and Morbid Anatomy at the Charing Cross Hospital.

NIXON, CHRISTOPHER J., B.A., M.D., LL.D., Physician to the Mater Misericordiæ Hospital, Dublin.

NORTON, ARTHUR T., Surgeon to, and Lecturer on Clinical Surgery at, St. Mary's Hospital.

POLLOCK, JAMES EDWARD, M.D., Consulting Physician to the Hospital for Consumption and Diseases of the Chest, Brompton.

PRINGLE, JOHN J., M.B., C.M., Assistant Physician, Lecturer on Practical Medicine, and Physician to the Skin Department, at the Middlesex Hospital.

RUSSELL, JAMES S. RISIEN, M.B., C.M., London.

SANSOM, ARTHUR ERNEST, M.D., Physician to, and Lecturer on Clinical Medicine at, the London Hospital; Consulting Physician to the North-East Hospital for Children.

SEATON, EDWARD, M.D., Lecturer on Public Health at St. Thomas's Hospital; Medical Officer of Health to the Administrative County of Surrey.

STONHAM, CHARLES, Assistant Surgeon to, and Lecturer on Operative Surgery at, the Westminster Hospital.

SUTTON, JOHN BLAND, Assistant-Surgeon to the Middlesex Hospital.

TAYLOR, FREDERICK, M.D., Physician to, and Lecturer on Medicine at, Guy's Hospital; Consulting Physician to the Evelina Hospital for Sick Children.

TAYLOR, JAMES, M.A., M.D., Assistant Physician to the National Hospital for the Paralysed and Epileptic.

TREVES, FREDERICK, Surgeon to, and Lecturer on Surgery at, the London Hospital.

TURNER, SIR WILLIAM, M.B., D.Sc., LL.D., D.C.L., F.R.S., Professor of Anatomy in the University of Edinburgh.

TWEEDY, JOHN, Professor of Ophthalmic Medicine and Surgery in University College; Ophthalmic Surgeon to University College Hospital; Surgeon to the Royal London Ophthalmic Hospital.

WHISTLER, W. MacNEILL, M.D., Physician to the London Throat Hospital.

WHITELEGGE, BENJAMIN A., M.D., B.Sc., D.P.H., County Medical Officer of Health, West Riding of Yorkshire; Lecturer on Public Health at the Charing Cross Hospital.

WILLIAMS, DAWSON, M.D., B.S., Assistant Physician to the East London Hospital for Children.

WRIGHT, ALMROTH EDWARD, B.A., M.D., B.Ch., Professor of Pathology in the Army Medical School, Netley.

DICTIONARY
OF
MEDICINE

A

ABDOMEN, Diseases of the.—Before entering upon the study of the particular diseases which are liable to be met with in connexion with each of the principal regions of the body, it is expedient to regard them from a general point of view, as such a course helps materially in clearing the way for their clinical investigation. This general survey is particularly advantageous in the case of abdominal diseases, which are necessarily very numerous and varied, both as regards the structures affected and the nature of the morbid changes they present; they are consequently difficult to recognise with certainty in many instances, and are occasionally involved in much obscurity.

Excluding a few peculiar affections, the diseases of the abdomen may be arranged under the following groups:—

I. Diseases of the anterior abdominal walls.

II. Diseases of the peritoneum and its folds.

III. Diseases of the organs contained within the abdominal cavity, namely:—1. Stomach and Intestines; 2. Hepatic organs, including the liver, gall-bladder, and gall-ducts; 3. Spleen; 4. Pancreas; 5. Supra-renal capsules; 6. Urinary apparatus, viz., the kidneys and their ducts, and the bladder; 7. Female generative organs, including the uterus and its broad ligaments, the Fallopian tubes, and the ovaries; 8. Absorbent glands.

IV. Diseases of the abdominal vessels, especially the aorta and the iliac arteries.

V. Diseases of the sympathetic or other nerves contained within the abdomen.

VI. Diseases originating in connexion with the cellular tissue, such as inflammation or abscess.

VII. Diseases springing from the posterior boundary of the abdomen; from the pelvis or the structures lining it; or from the diaphragm, and invading the abdominal cavity.

VIII. Diseases encroaching upon the abdomen from other parts, especially from the thorax.

It must be borne in mind that the groups of diseases above mentioned may be presented in various combinations, two or more structures being not uncommonly implicated at the same time.

The special nature and mode of origin of the diseases thus summarised will be discussed under their appropriate headings, but a few general observations on this subject may prove serviceable. Several of the abdominal organs are very liable to so-called *functional disorders*, being much exposed to the repeated action of various disturbing influences, and these disorders often give rise to prominent and troublesome symptoms, which are urgently complained of by the patient. Definite *organic diseases* are also of common occurrence, many of them being of a very serious character. Some of the organs contained within the abdomen are liable to *malposition* or *displacement*, as well as to *malformations*, these being either congenital or acquired; while the hollow viscera may be the seat of *obstruction* or *accumulations* of different kinds. Each of these conditions may become clinically important.

Abdominal lesions are frequently purely *local* in their origin, but several of them are but local manifestations of some general condition, being associated either with certain acute febrile diseases, *e.g.* typhoid fever; or with some constitutional cachexia, such as cancer. Again, symptoms connected with the abdomen may depend upon disease in some remote part of the body; or some of its organs may become the seat of morbid changes as a consequence of disease in other structures. For instance, vomiting is frequently associated with cerebral disorders; while affections of the heart are liable to lead to troublesome symptoms, as well as to serious lesions, in connexion with many of the abdominal viscera. Lastly, a morbid condition of one organ within the abdomen may be the direct means of originating *secondary* mischief in other structures.

Clinical Investigation.—The clinical examination of cases in which the symptoms point to the abdomen as the seat of mischief should always be conducted with particular care and thoroughness, as well as in a systematic manner, otherwise serious mistakes are liable to be made. It is also very desirable to avoid forming any definite conclusion as to the nature of the complaint hastily or on insufficient data, but rather to wait and observe the course of events in any doubtful case, repeating the investigation from time to time, when any obscurity which may exist will often be cleared away. The past and family history of the patient, with the course and progress of the symptoms, are often of material assistance in diagnosis, and demand due attention in every instance. The chief clinical phenomena which may be associated with abdominal affections, and with reference to which it is requisite to inquire, may be thus indicated. First, there are usually symptoms directly connected with the structure implicated, such as pain and other morbid sensations, disorders of secretory or other functions, or excited action. Secondly, several of the organs mutually affect each other, either from being anatomically or physiologically related, or from a morbid condition of one part causing pressure upon or irritation of some neighbouring structure. In this way numerous symptoms are liable to arise, sometimes in remote parts, and often of material significance. Thirdly, sympathetic or reflex phenomena in connexion with organs in other regions of the body are frequently excited by many abdominal disorders, such as palpitation of the heart, convulsions, and other nervous disturbances. Fourthly, the general system often suffers seriously, and in various ways. For instance, pyrexia may be excited; the blood may become impoverished or impregnated with noxious materials; or more or less general wasting and debility may be induced. Where an abdominal disease is but a local manifestation of some constitutional condition, it commonly aggravates materially the general symptoms; while in connexion with lesions of certain of the abdominal viscera these general symptoms constitute in many cases the most prominent clinical features. Fifthly, morbid conditions within the abdomen not unfrequently interfere directly with the diaphragm and the thoracic organs; occasionally also they encroach upon the chest, or actually make their way into this cavity through the diaphragm. In rare instances morbid products, such as pus, may find their way to distant parts of the body. In these different ways a variety of symptoms may be caused, sometimes of a curious nature and difficult to explain. Lastly, abdominal diseases are frequently attended with abnormal physical or objective signs, which are revealed on physical examination, and these are of such importance that they demand separate consideration.

Physical Examination.—The neglect of submitting patients to a satisfactory physical examination is a frequent source of error in diagnosis in cases of abdominal disease, and there ought to be no hesitation or delay in resorting to this method of clinical investigation whenever it seems called for. The precise course to be pursued must vary according to circumstances, but the following outline will serve to indicate the plan of procedure ordinarily required.

First, there are certain modes of examination which are applied to the abdomen externally, including *Inspection*; *Palpation* or *Manipulation*; *Mensuration* or *Measurement*; *Percussion*; and *Auscultation* (*see* Physical Examination). Of these, inspection, palpation, and percussion are by far the most important, and have, in the large majority of cases, to be relied upon for the information required. In exceptional instances *Succussion*, or shaking the patient, proves serviceable, by bringing out certain sensations or sounds. In order to carry out these methods properly, it is necessary to expose the abdomen sufficiently, due regard being paid to decency in the examination of females; to place the patient in a suitable position; and to see that the muscles of the abdominal walls are duly relaxed. The best position usually is for the patient to lie on the back, in a half-reclining attitude, with the head and shoulders well raised, and the thighs and knees more or less flexed. This posture serves to relax the abdominal muscles, which may be further aided by taking off the patient's attention by conversation or in other ways, as well as by directing him to breathe deeply. The position, however, has often to be varied in the investigation of particular cases, and much information is frequently gained by noticing the effects of altering the posture.

The objective conditions which may be revealed by the modes of examination thus far considered are as follows:—1. The state of the superficial structures. 2. The size and shape of the abdomen, generally and locally, as indicating an alteration in the volume of the ordinary contents of the abdomen, or the presence of some new or fresh element, such as dropsical fluid or a tumour. 3. The characters of the abdominal respiratory movements; and the presence of any unusual sensations during the act of breathing, such as friction-fremitus. 4. The sensations experienced on palpation and percussion over the abdomen, either as a whole, or in any particular part of it, such as its mobility, degree of resistance, regularity, consistence, &c.; as well as the presence of certain peculiar sensations, *e.g.*, fluctuation, or hydatid-fremitus. 5. The presence and characters of any pulsation. 6. The occurrence of abnormal movements within the abdomen, as those of a fœtus. 7. The sounds elicited, generally and locally, on percussion. 8. The presence of certain sounds within the abdomen, heard on auscultation, such as friction-sounds; murmurs connected with aneurysm or due to pressure on an artery; or murmurs and sounds associated with the pregnant uterus.

Secondly, it not uncommonly happens that special modes of examination have to be applied to particular organs within the abdomen, in order to arrive at a diagnosis with any certainty. And here it may be remarked that it is highly important in all cases to see that no accumulation of fæces exists within the bowel, and that the bladder is properly emptied, otherwise very serious mistakes are liable to be made. Purgatives and enemata are needed in order to remove any fæcal collection. The urine should also be properly tested in every instance; and much information may often be gained in the investigation of affections of the alimentary canal, from a personal inspection or more complete examination of fæces or vomited matters. The abdominal organs to which special modes of examination are chiefly applicable are the female generative organs, which are investigated per vaginam (*see* WOMB, Diseases of); the bladder, by means of the catheter, the sound, and other surgical instruments; the stomach, by the use of the stomach-pump, probang, &c.; and the intestines, by examining with the finger, hand, or surgical instruments per rectum, or by injecting water or air through the anus into the bowel. The ordinary modes of examination already mentioned may afford assistance when employed along with some of the special methods just indicated.

Thirdly, occasionally it is requisite to have recourse to exceptional modes of investigation, such as the use of the exploring trocar or aspirator; or to the administration of chloroform. The latter may afford direct information in certain abdominal conditions, and it may also materially assist in carrying out other methods of exploration. Now and then more serious operative procedures have to be adopted for diagnostic purposes.

The abnormal conditions discoverable by physical examination may involve the entire abdomen, giving rise, for instance, to general enlargement or retraction; or they may be limited to some particular region, as exemplified by enlarged organs, tumours, or abscesses. This part of the body has been artificially divided by anatomists into regions, and the seat of any local morbid condition can thus be defined and described. The diseases peculiar to the several regions will be considered under their respective headings.

FREDERICK T. ROBERTS.

ABDOMINAL ANEURYSM.—Abdominal aneurysm includes aneurysm of the aorta, and of any of its branches within the abdomen.

Aneurysm of the Abdominal Aorta is essentially a disease of middle age. Of 59 cases collected by Dr. Crisp, 33 were under the age of forty. It is more common in the male than in the female sex, in the proportion of about 8 to 1; and is usually traceable to strain, or to a blow upon the abdomen or back. The aneurysm is most frequently located in that portion of the vessel included between the aortic opening in the diaphragm and the origin of the superior mesenteric artery, being seldom met with below this point. In this situation the tumour is deeply seated; liable to tension from the crura of the diaphragm; and likely to involve the great splanchnic nerves, the semilunar ganglia, and the solar plexus. Hence the occasional difficulty of diagnosis; and the frequency of boring pain in the back from erosion of the vertebræ, and of paroxysms of radiating pain in the abdominal viscera from stretching of the adjacent nerves. When situated lower down in the course of the aorta, the disease is less obscure, and the symptoms are less urgent. Aneurysm of the abdominal aorta is usually of the *false* variety; and, as contrasted with thoracic aneurysm, it is less often associated with extensive atheroma of the aorta, and with fatty or other structural disease of the heart. The symptoms referable to excentric pressure are also fewer, and, with the exception of pain, are less urgent than in the thoracic variety.

SYMPTOMS AND SIGNS.—Of the symptoms, *pain* is the most characteristic and the most urgent; it is of two kinds, which are not, however, necessarily associated. In its usual form the pain of abdominal aneurysm is essentially neuralgic; it is intermittent, lancinating, and paroxysmal,—encircling the body like a girdle, or radiating through the abdomen, back, pelvis, and base of the thorax, and not infrequently into either groin or testicle. The accession is sudden, and usually attributable to some definite cause of vascular excitement. The duration extends over a period varying from one to three hours, rarely longer; and the cessation is equally abrupt, leaving the patient in a state of exhaustion, but quite free from actual suffering. The second kind of pain referred to is continuous and boring; fixed at a particular point of the vertebral column; aggravated by pressure at this point, by active movement or stamping, and by gently turning the patient half round upon his axis in the standing posture; but relieved by assuming the prone position or by leaning forward. Pain so characterised is pathognomonic of erosion of the vertebræ. Pressure of an aneurysm may affect the functions of several organs within the abdomen. Thus *jaundice* may result from pressure upon the hepatic or common biliary duct: it is, however, more frequently due to an aneurysm of the hepatic or of the superior mesenteric artery. *Interference with the urinary* *secretion*, and the consequences thereof, from pressure upon the renal vessels; *dysphagia*, from pressure upon the œsophagus; *vomiting*, from obstruction of the pylorus; *displacement* of the liver forwards, or of the heart upwards—though rare symptoms—may be likewise due to the same cause. The radial pulse is not often affected. Symptoms of *constitutional* irritation and impaired nutrition are rarely exhibited, and appear only at the termination of protracted and painful cases, associated with great suffering and want of sleep.

The *physical signs* are those discoverable by inspection, palpation, percussion, and auscultation. The tumour usually projects to the left of the mesial line, and tends to descend; it is smooth and elastic; communicating to the hand alternate movements of lifting and expansion with increasing tension, and of subsidence with relaxation. The pulsation is all but invariably single, and synchronous with the radial pulse; it is limited to the tumour, and occasionally accompanied by thrill. Pressure upon the aorta below the tumour will increase the force of impulse, diminish or abolish the thrill, and arrest the collapse. In a few recorded examples the tumour was hard and uneven on the surface, and non-expansile; and in a still smaller number no pulsation was perceptible, the aperture of communication with the artery having been blocked, or the vessel compressed on the proximal side by the growth of the aneurysm itself. Owing to the position of the hollow viscera in front, and the mass of lumbar muscles behind, the evidence from percussion is less conclusive in regard to abdominal than thoracic aneurysm. If, however, the abdominal muscles be relaxed, and the stomach and bowels free from flatus, absolute dulness to the extent of the tumour may be detected. A sound, single or double, as distinguished from murmur, is rarely heard in front in connexion with abdominal aneurysm; whereas the existence of sound without murmur, and usually double, at a point of the posterior wall of the abdomen corresponding to the tumour, is the rule, and, when detected, is of the utmost diagnostic value. Murmur in the recumbent posture is rarely absent in front; it is single, blowing, prolonged, post-systolic, and not transmitted into the vessel beyond. It may, however, be musical, or it may present both these characters, but at different points of the tumour; in one instance it was of a buzzing quality. Should the aneurysm have taken an exclusively backward course, which is the exception, a single murmur, not audible in front, may be heard in the back. In a few recorded cases a double murmur has been heard over the aneurysm in front. In the erect posture the murmur is usually suspended; but in a few published cases it was audible in both the erect and the recumbent posture, and in one at least in the erect posture only. These peculiarities depend upon the various conditions of the sac, its orifice, and its contents. A small aneurysm engaging the posterior wall of the vessel only, and eroding the vertebræ, may be latent as to physical signs, though attended with severe fixed pain in the back. In some cases a slight retardation of the pulse in the femoral arteries has been noted.

Diagnosis.—The diagnosis of abdominal aneurysm has reference mainly to its physical signs. Strong pulsation of the aorta, simulating that of aneurysm, may exist in connexion with hysteria, uterine or intestinal irritation, dyspepsia, or marked anæmia. But in all these cases, irrespective of the positive and specific evidence presented by each, throbbing exists throughout the aorta, and is propagated into the main arteries of the lower limbs, whereas it is localised and expansile in aneurysm; and a careful exploration of the aorta—if necessary, under the influence of chloroform—will show that its dimensions are at all points normal. In these cases, too, although a murmur may be produced by strong pressure with the stethoscope, it does not exist when pressure is withdrawn. A cancerous or other tumour pressing upon the aorta may likewise produce murmur, and may exhibit pulsation communicated from the aorta; but in most cases both these phenomena are promptly arrested by placing the body in the prone position; the tumour, in that position, gravitating *from* the vessel. The fixed local pain in the back, aggravated by pressure and motion, may be simulated by ordinary lumbago; and the paroxysmal visceral pain by biliary colic. The differential diagnosis must rest upon the specific evidence in each case, and upon the absence of the signs of aneurysm.

Aneurysm of the Branches of the Abdominal Aorta.—The branches most liable to aneurysm are the common iliacs and their divisions; the cœliac axis and its branches; the renal, and the superior mesenteric. *Aneurysm of the Iliac Arteries* belongs to the domain of surgery, and will not be further referred to here. *Aneurysm of the Cœliac Axis* and of its branches of division, and of the *Superior Mesenteric Artery*, are, in addition to the ordinary signs, equally characterised by mobility of the tumour; and the first two varieties by the occurrence of jaundice, hæmatemesis, and melæna, from pressure. Renal aneurysm may cause obstruction in the kidney, or renal colic, by pressure on the structures in the hilus.

Duration and Terminations.—The duration of life in abdominal aneurysm in a number of cases observed, varied from fifteen days to eleven years. Death occurs usually: (1) by rupture of the sac into (*a*) the retro-peritoneal tissues; (*b*) the cavity of the peritoneum; (*c*) the left pleura or lung; (*d*) the intestinal canal; (*e*) the inferior cava; (*f*) the psoas muscle; (*g*) the pelvis of the kidney; (*h*) the spinal canal; or (*i*) the ureter, biliary passages, or œsophagus; the order given represents the relative frequency of the fatal result; or (2) by exhaustion or syncope. The duration of life after the rupture of the aneurysm has ranged from a few minutes to several weeks. A consecutive false aneurysm, retroperitoneal in site, is specially characterised by feeble pulsation of the tumour, and diminished or arrested circulation in the femoral artery of one or both sides.

TREATMENT.—The *curative* treatment of abdominal aneurysm may be considered under three heads—*operative, postural* and *dietetic*, and *medicinal*. *Operative* treatment consists in pressure applied to the aorta on the proximal side of the sac, or simultaneously on its proximal and distal sides, by means of tourniquets, so as completely to stop the circulation. The bowels should be first well moved and freed from flatus; and during the continuance of pressure the patient should be kept under the influence of chloroform or ether. As a rule, compression should not be employed above the level of the duodenum. Five cases, if not more, in which a cure was effected by these means have been reported. The object sought to be attained being that of effecting rapid coagulation in the sac, the period during which pressure needs to be continued in these cases varies from three quarters of an hour to ten hours and a half. Where space for the application of proximal pressure does not exist, distal pressure alone may be tried. Under all circumstances, pressure must be used with care, as inflammation of the peritoneum or of the bowels has been known to result from it. Galvano-puncture, and the introduction of iron wire into the aneurysmal sac (Moore's treatment), have also been employed. In a small proportion of cases the latter method has been attended with a favourable result.

Bellingham introduced the plan of treatment by *posture and restricted diet*. Under this plan perfect repose of mind and body is, as far as practicable, to be maintained; the bowels being kept moderately free, and the dietary restricted to 10 oz. of solids and 6 oz. of liquids daily. According to the method of the late Mr. Tufnell, which is based upon the same principle, but is more rigid, the patient is strictly confined to the horizontal posture for a period varying from eight to thirteen weeks, as determined by the effect upon the aneurysm, movement in bed being effected with caution; whilst, by a special arrangement, the bowels and the bladder may be evacuated without disturbance of the body. For breakfast, 2 oz. of white bread and butter, with 2 oz. of cocoa or milk, are allowed; for dinner, 3 oz. of meat, with 3 oz. of potatoes or bread, and 4 oz. of water or claret; and for supper, 2 oz. of bread and butter, and 2 oz. of milk or tea. The total amount in the twenty-four hours would be: solids 10 oz., liquids 8 oz. This system might be in some degree relaxed if the patient proved restive. Mild laxatives and opiates as required are the only medicines used. Ten cases of the successful treatment of aortic aneurysm by this method have been reported by Mr. Tufnell. Abdominal aneurysm was solidified in two instances, after treatment extending over thirty-seven and twenty-one days respectively.

Of the various *medicinal* agents used with a view to favouring or effecting a deposit of laminated fibrin in the sac, acetate of lead, iodide of potassium, aconite, and ergotin (administered hypodermically), alone claim attention. Iodide of potassium may be given with advantage in doses of 10 to 20 grs. thrice daily, with a view to reducing vascular tension, and thereby relieving pain and promoting deposition in the sac, whilst perfect rest in the recumbent posture and a restricted dietary are observed. The latter are, however, the more important factors in the treatment. Dr. G. W. Balfour has reported several cases successfully treated by means of iodide of potassium; and an example of a similar kind was subsequently published by Sir Dyce Duckworth. Dr. Grimshaw has recorded an example of cure mainly through the use of aconite. In all cases the allowance of liquids must be reduced to the lowest possible standard, whilst excretion is promoted. Alcoholic stimulants may be given in small quantity and at long intervals, if the pulse exhibit debility and the patient complain of a sensation of sinking; otherwise they should be prohibited.

The *palliative* treatment as applied to abdominal aneurysm will be found described in the article AORTA, Diseases of (*Aneurysm*). The application of a few leeches, followed by a warm poultice, is very efficacious in relieving pain. The hypodermic use of morphine is still more rapidly effective.

THOMAS HAYDEN. C. J. NIXON.

ABDOMINAL TYPHUS. — A synonym for typhoid fever. *See* TYPHOID FEVER.

ABDOMINAL WALLS, Diseases of.—But little more will be needed in this article than to give a brief outline of the nature of the affections to which the abdominal walls are liable, as most of these are but local forms of diseases which are fully described in other parts of this work. The parietal peritoneum will be excluded from consideration, as its morbid conditions are treated of separately.

1. SUPERFICIAL AFFECTIONS.—*a.* The skin covering the abdomen may be the seat of various eruptions. The rash of typhoid fever is chiefly observed over this region.

b. When the abdomen is greatly enlarged, its cutaneous covering becomes stretched and thinned, often presenting a shining appearance; or it may even give way, so that it exhibits superficial cracks or fissures. If it has been distended for a considerable time or on several occasions, as after repeated pregnancies, the skin becomes impaired in its nutrition, and is often the seat of permanent white lines or furrows—*lineæ albicantes.* In this connexion allusion may be made to the umbilicus, which, in certain forms of distension of the abdomen, may become pouched out, everted, or actually obliterated. *c.* The veins of the skin frequently become enlarged and tortuous, when the return of the blood which is normally conveyed through them is in any way impeded. The particular vessels which are distended will necessarily depend upon the seat of the obstruction. *d.* The cutaneous sensibility over the abdomen is sometimes materially altered. In certain nervous diseases it may become more or less impaired or lost; but the most important deviation is a marked increase of sensibility—*hyperæsthesia*—which is occasionally observed in hysterical females, and which may simulate more serious affections, particularly peritonitis, especially if it is accompanied with symptoms of much depression. This condition is characterised by extreme *superficial* sensibility or tenderness of the abdomen, the slightest touch being resented; but if the patient's attention can be taken off, and deep pressure be then made, this is borne with little or no indication of distress. The aspect of the patient, the presence of other symptoms indicative of hysteria, and the absence of pyrexia usually serve to distinguish this affection from others of a graver nature. The surface of the abdomen may also be affected with neuralgia, which is sometimes very severe.

2. Subcutaneous Accumulations.—*a.* The chief morbid condition coming under this head is *œdema* or *dropsy* of the subcutaneous tissue. This generally follows anasarca of the legs, and may be associated with ascites. The fluid tends to collect especially in the lower part of the abdominal walls and towards the flanks. The skin often presents a white pasty aspect; the abdomen may be more or less enlarged; the umbilicus appears depressed and sunken, if the œdema extends up to this level; the superficial structures pit on pressure, and yield the peculiar sensation of dropsical tissues; and the percussion note is frequently muffled. *b.* The abdominal subcutaneous tissue is, in many persons, the seat of an abundant collection of fat, which may be important from causing apparent enlargement, and simulating or obscuring other more serious morbid conditions which enlarge the abdomen. *c.* In rare instances gas accumulates under the skin in this region, constituting *subcutaneous emphysema.* The abdomen then appears to be enlarged, but the condition is readily recognised by the peculiar crackling or crepitant sensation felt on digital pressure; the resonant or tympanitic sound elicited by percussion; and the dry crepitant sound heard when pressure is made with the stethoscope.

3. Affections of the Muscles and Aponeuroses.—*a.* The abdominal walls may be the seat of muscular rheumatism, which is particularly likely to follow undue straining, such as that caused by violent coughing or vomiting. It is characterised by pain, sometimes severe, evidently located in the muscular and tendinous structures, accompanied with much soreness and tenderness. The affected parts are kept as much at rest as possible, and any action which disturbs them materially aggravates the pain. *b.* As the result of violent strain, the muscular or aponeurotic tissues may be more or less torn or ruptured, or the normal openings enlarged. As a consequence a protrusion of some internal structure is likely to take place, forming a hernia. *c.* The abdominal muscles are liable to be the seat of spasmodic contraction, cramp, or rigidity. These disorders are not uncommonly excited in sympathy with grave disturbance of the alimentary canal, as in cholera. In certain painful internal affections, also, some of the abdominal muscles are occasionally kept in a state of more or less rigid tension, as if they were involuntarily contracted in order to protect the diseased parts underneath from injury. The spasmodic contractions in tetanus not infrequently cause great suffering over the abdomen. *d.* On the other hand, the abdominal muscles are occasionally paralysed, as the result of centric nervous disease. The movements of respiration are then altered in character; while the expulsive acts in which the abdominal muscles naturally take part are much interfered with.

4. Relaxed Abdominal Walls.—All the structures forming the walls of the abdomen are often in a relaxed and flabby state, yielding to any pressure from within, so that the abdomen becomes enlarged and prominent, especially if, as is frequently the case, this condition is associated with much flatulence. It materially weakens the act of defæcation, and promotes constipation.

5. Inflammation and Abscess.—Local inflammation may be set up in any of the abdominal structures, and this may terminate in suppuration and the formation of an abscess. Purulent accumulations from within, as in cases of pelvic abscess, as well as certain abscesses originating in diseases of bones or joints, may likewise extend among the tissues of the abdominal walls, causing thickening and induration, or may make their way outwards, directly or through a sinus. Subsequently permanent sinuses or fistulæ may be left.

6. The abdominal wall may be the seat of *extravasation of blood*; and various kinds of *tumour* or *new growth* may form in its structures. FREDERICK T. ROBERTS.

ABERRATION.—A divergence or wandering from the usual course or condition; applied in medicine chiefly to certain disorders of the mental faculties. *See* INSANITY.

ABORTION.—The *act of abortion* signifies the expulsion of the contents of the pregnant uterus before the seventh month of gestation. *An abortion* is a designation given to a fœtus prematurely expelled. *See* MISCARRIAGE.

ABSCESS (*abscedo*, I depart). SYNON.: Fr. *abcès*; Ger. *Eiterbeule; Geschwür.*

DEFINITION.—A collection of purulent matter, one of the results of inflammation. *See* INFLAMMATION.

PATHOLOGY.—If the material which collects in a tissue as the consequence of inflammation softens and becomes liquid (suppuration), it does so either rapidly or slowly: if the former, the result is an *acute* abscess; if the latter, the abscess is termed *chronic* or *cold.* If the material thus softened and forming pus, often mingled with fragments of dead tissue, is limited by the condensation of the parts around, which are usually consolidated by the products of inflammation, the abscess is said to be *circumscribed*; but if the surrounding parts in their turn soften, so as practically to offer no barrier to the pus, then the abscess spreads and is said to be *diffused.* The term 'diffused suppuration' is, however, in this case, more usually employed. In an *acute circumscribed* abscess the lymph which collects around it as the result of inflammation becomes organised and forms a sac (pyogenic membrane); and this, with the compressed tissue about it, constitutes the wall; the entire abscess consisting therefore of contents (pus), of a limiting sac, and of condensed tissue around. The resistance offered to the extension of the suppuration is greatest when the parts adjacent are dense and tough, such as bones and fascia; yet, as the pus in an abscess increases in quantity, probably by breaking down of the pyogenic layer, sufficient pressure is exerted to cause the most dense structures ultimately to yield, and an abscess will thus make its way even through osseous tissue. As might be expected, an abscess always advances in the direction of least resistance, and this extension is spoken of as its *pointing.* This pointing may be towards the surface of the body, but an abscess may direct itself towards a serous cavity, such as the peritoneum; or along a track of cellular tissue, as when pus beneath the deep cervical fascia points into the mediastinum. On the side at which the abscess is pointing, its wall, as the resistance lessens, projects; and by ulcerative absorption the parts covering it become quickly thinner, until they and the abscess-wall give way and the pus escapes. In by far the greater number of cases this absorption of tissue before the pointing abscess is towards the surface, and it is by ulceration of the skin that the opening for the discharge of the matter is effected. The wall of the abscess then contracts, pus continuing for a time to be discharged; and in the end, aided by the resilience of the tissues around, the sac of the abscess is obliterated, and the orifice through which its contents were discharged heals by granulation process. To ensure this result the walls must be left at rest, or the granulations which cover them may fail to unite, and the obliteration of the sac will not then take place. This happens, for example, in the case of an abscess situated between the movable rectum on the one side and the ischium on the other, where the opposite abscess-walls are prevented from joining by muscular movements on the side of the bowel, and will only unite after such movements have been stopped by cutting across the muscular fibres which occasion them. The track which results from such failure of the healing of an abscess is called a *sinus* or *fistula.*

In a *diffused* abscess the inflammation of the parts around does not limit the suppuration by organisation of the effused lymph, but such lymph, itself degenerating, forms more pus, and so the abscess extends rapidly and widely, unless checked by some barrier of dense tissue. In this way matter often spreads along tracts of cellular tissue, as along the course of veins, and in the subcutaneous structures. An abscess when formed between bone and periosteum, or otherwise hindered from reaching the surface by pointing, also tends to diffuse itself by following the course of least resistance. In most of these cases, by direct pressure upon the resisting tissue, or by cutting off the blood-supply (as of the skin when its subcutaneous tissue is infiltrated with pus), sloughing of the parts covering in the abscess ensues, oftentimes to a considerable extent, and so the pus eventually makes its way to the surface.

A *chronic* abscess begins in some local inflammation without active symptoms, such as results in the deposit of aplastic lymph and subsequent ulcerative changes, as caries of bone, the irritation leading to suppuration. The formation of matter or 'pus' proceeds in a languid manner, so that it is only by slow degrees that it collects in any considerable quantity, although eventually these chronic abscesses may acquire great size. They slowly point, and in their tardy advance occasionally traverse even serous cavities, which have been first obliterated in the line of transit by adhesive inflammation of their opposed surfaces: in this way an abscess formed in the liver (and this holds good also for those of a more acute character) may travel through the layers of the peritoneum, and may point through the anterior wall of the abdomen.

When an abscess discharges, its contents are seen to be either a thick yellow (*laudable*) pus, or pus stained with blood, or otherwise coloured, such as black or bluish-green; or the pus may be thin, almost watery, mingled with flakes of lymph; it may be inodorous or fœtid, or irritating to the skin (*ichorous*). Abscesses may also contain sloughs of tissue, foreign bodies, masses of inspissated pus as hard occasionally as calculi, fragments of dead bone, or calculi of various kinds. Sometimes a chronic abscess ceases to enlarge; and if the irritation which occasioned it comes to an end, it may diminish by absorption of the fluid part of its contents, the solid part drying up into a shrunken putty-like mass. It may remain in this state without giving rise to further trouble, or it may become again the seat of suppuration by the formation of what under such circumstances has been termed by Sir James Paget a *residual* abscess; this term 'residual' being also applied to an abscess which has formed at the site of old inflammatory processes, although these may never have advanced previously to actual suppuration.

The *progress* of any abscess is largely influenced by the state of the general health. In persons otherwise robust an abscess commonly runs an acute course; in those weakened by acute illness, such as scarlet fever or typhus, they form quickly, but are slowly recovered from, and severely tax, by an exhausting discharge, the powers of the patient. Persons in feeble health, hereditary or acquired, usually suffer from the chronic and diffused forms; and chronic affections of internal organs, as of the liver or kidneys, are not infrequently associated with the development of such abscesses.

Ætiology.—The cause of an *acute* abscess may be an injury, such as a blow or pressure, as often happens in persons weakened by continued fever; exposure; or the irritation of a foreign body, or that of a poison introduced from without. In the last case the abscess is often diffused. Abscess running an acute course may also be due to a foreign body or to an irritant from within, as when it follows necrosis of a portion of bone, or the escape of urine into the tissues of the perineum. It also arises in connexion with blood-poisoning, as in various fevers, and affections distinguished as septic. The cause of a *chronic* abscess is usually found in changes which go with deposits of a tuberculous character; or it is found in the changes which slowly occur around an irritating body, such as a renal calculus; or chronic inflammation may culminate in one of these collections of matter. They may also form in parts which are long congested in connexion with obstructed venous circulation (*varix*); and they may follow, or conditions closely allied may follow, the occlusion of a main artery and the consequent cutting off of the supply of blood to a particular region.

Symptoms.—The symptoms of an *acute* abscess are those of a local inflammation, with constitutional disturbance if the abscess is of any size; followed by a sense of cold or actual shivering, with increase of pain and swelling, tenderness, and throbbing. The tenderness can be recognised in the case of most abscesses; and, if pus is formed anywhere near the surface, the presence of the fluid is detected by its fluctuation. The severity of the pain is much influenced by the site of the abscess, as when the pus is held down and hindered from pointing by dense structures, such as fasciæ. Special symptoms may also arise in connexion with the situation of the suppuration, as when urgent dyspnœa is caused by the pressure on the larynx of an abscess deeply seated at the base of the tongue. A *diffused* abscess, if subcutaneous, is recognised by its rapid spreading, and may be suspected if other signs point to a part as the site of the abscess in which diffusion is the rule.

Of *chronic* abscess there is seldom any evidence in its early stage. The symptoms, if any, are those of failing health, and for the rest are marked by those of other changes from which the abscess is an outcome. Thus in disease of the hip-joint or of the spine, unless an attack of shivering chances to attract attention, an abscess is not, as a rule, suspected until it has broken through its first limits, and has attained considerable size. Our limits do not permit an examination of the symptoms which serve to distinguish between chronic abscess and other swellings, such as extravasated blood or soft tumours, especially malignant tumours; but this is the less requisite, for if a doubt in any case arises, it can be at once solved by the introduction of a grooved needle or of a fine trocar into the swelling. The true pulsation of an aneurysm sufficiently tells its nature, and is not easily mistaken for the impulse sometimes given to an abscess by an adjacent artery.

Varieties.—The chief local varieties of abscesses which are likely to be met with in medical practice may be thus arranged:—1. Subcutaneous or more deeply seated abscesses in the limbs, in connexion with low fevers, erysipelas, pyæmia, &c. 2. Abscesses of local origin in the walls of the abdomen or chest. 3. Abscesses originating in serous membranes. 4. Certain special abscesses associated with diseased bone, *e.g.* psoas and lumbar abscess. 5. Abscesses formed in the cellular tissue around organs, *e.g.* peri-nephritic, peri-cæcal, &c. 6. Abscesses originating in inflammation of organs, the chief of which include hepatic, renal, pyelitic, pulmonary, mammary, cerebral, splenic, pancreatic. 7. Obscure abscesses formed in the deep cellular tissue, *e.g.* retro-pharyngeal, ischio-rectal, mediastinal. 8. Glandular abscesses, which are usually chronic, and of a scrofulous nature. 9. Suppurating hydatid cysts.

TREATMENT.—The treatment of an *acute* abscess consists in rest; soothing local applications, of which poppy or plain water fomentations, and warm poultices, as of boric wool or linseed-meal, are usually the best; and the use of remedies to allay pain and constitutional disturbance, if required. As soon as the presence of pus is recognised the abscess must be opened, if possible where the matter is most dependent; and as soon as its contents have escaped, all troublesome symptoms will usually disappear. The opening is needed to relieve pain, in some cases to prevent diffusion of pus, and sometimes to relieve urgent distress, as when dyspnœa is caused by the pressure of an abscess upon the air-passages. It is also desirable to open an abscess to avoid the considerable scar which must result if the matter is left to escape by ulceration or sloughing of the superficial tissues. In most cases it is necessary to open an abscess by an incision. A narrow knife should be used; and if the matter is deeply seated, the superficial parts only need be cut, the deeper being torn through, as the late Mr. Hilton recommended, by a steel director and by dressing-forceps, the risk of dividing important structures, as in the neck, being thus avoided. After the abscess has been punctured, it should be left to contract by the resiliency of its own walls, all squeezing and handling being carefully refrained from, as harmful and unnecessary, and giving the patient needless pain. The wound should be kept open, if necessary, by means of a drainage-tube, or a slip of thin gutta-percha tissue or of oil-silk, and should be covered with absorbent carbolic gauze, iodoform wool, or some other of the numerous antiseptic dry dressings now employed for this purpose; or, where moist applications are needed, by wet boric lint or wool, or by a linseed-meal poultice. In some cases it is necessary to protect the wound, whilst operating, by means of the carbolic spray, or by a piece of linen steeped in carbolic lotion (1 in 20), or by taking some other antiseptic precautions. The drainage-tube should be withdrawn after the first day if the abscess is superficial, but if the pus has been deeply seated it should be only gradually withdrawn, portions being cut off as the abscess contracts. If a foreign body has caused the formation of the abscess, it must be sought for and removed before the suppuration can be expected to cease. Occasionally the vascular wall of an abscess bleeds freely, or a vessel is opened in its progress. The hæmorrhage usually ceases on laying the abscess freely open; but if this does not suffice, it may be permanently controlled by pressure, and cases are rare in which further operative interference is called for. Inflammation of the sac used formerly not infrequently to follow the discharge of its contents, but under the treatment now employed such an occurrence is unknown. During the healing of any considerable abscess the general health should be attended to, and tonics and change of air may be useful to expedite recovery.

Diffused abscesses, whether subcutaneous or more deeply seated, require free incisions as soon as suppuration is even suspected, so as to avoid the damage which results from their spreading, and from the sloughing of tissue, as of the skin, which will otherwise occur; and this treatment is especially called for in the case of those due to poison introduced into the system, and those caused by infiltration of urine. These abscesses sometimes lead to fatal results.

A *chronic* abscess may have its contents drawn off by the aspirator; or it may, when it has come near the surface, be opened, drained, and dressed as above, but its ultimate closing will depend upon the removal of the cause; if, for example, it is due to disease of a joint, it cannot be cured until the disease in which it has originated has in some way ended. In some cases of suppurating lymphatic glands it is well to scrape out their interior, after making a clean incision into them, and to apply iodoform or some other antiseptic to the cavity which is left.

Sinus.—An abscess after being opened may contract until it forms a narrow track, *sinus* or *fistula*, leading to the site of primary irritation. Such a track has a dense fibrous wall from which purulent fluid escapes. It may also convey secretions, as from the liver (*hepatic fistula*) or stomach (*gastric fistula*), or excretion, as from the kidneys; or it may simply carry out the pus which forms around some irritant at the deep extremity, such as a foreign body, or a portion of carious or necrosed bone. Some such fistulæ are due to the movements of adjacent muscles preventing union of the abscess-walls. Unless the cause of the sinus can be removed, as by extracting necrosed bone, these fistulous tracks are difficult to manage, requiring special treatment according to their situation. Other *fistulæ* are those forming communications between mucous canals (*recto-vesical, vesico-vaginal fistulæ*); and these need special treatment, such as plastic operations, and operations diverting the course of excreta escaping through unnatural channels.

The tissue about healed abscesses, scar-tissue generally, and tissue spoiled by inflammation, are apt on slight provocation to inflame and suppurate, and to these collections of matter the term '*residual*' has been applied. The treatment of such abscesses in no way differs from that of others, and they usually heal in the ordinary manner.

G. W. CALLENDER. W. MORRANT BAKER.

ABSINTHISM. — DEFINITION. — The condition induced by an excessive consumption of absinthe.

From the mode in which absinthe is taken, we should expect that the symptoms induced by its excessive consumption would be generally obscured by, and intermixed with, those of alcohol (*see* ALCOHOLISM). That it has a special effect on the organism, and that this may be diagnosed from alcoholism, has been pointed out by Motet, Magnan, and other French physicians; and Magnan has clearly exemplified its action by numerous experiments on dogs. In persistent absinthe-drinkers, vertigo and epileptiform convulsions are marked symptoms, and come on much earlier than when alcohol, in other forms, is habitually drunk. Hallucinations occur also without any other symptom of delirium tremens; and, when tremors coexist, these are limited more particularly to the muscles of the arms, hands, and shoulders. Absinthe acts chiefly on the cervical portion of the spinal cord, and this readily explains the special symptoms arising from its regular use in excessive quantities. JOHN CURNOW.

ABSORBENT AGENTS.—In *surgery*, absorbents are substances used to absorb fluids, as sponges, charpie, or tow; in *medicine*, drugs which neutralise excessive acidity in the stomach—a synonym for alkalis (*see* ALKALIS). The term is sometimes also made use of to designate remedies, such as the preparations of mercury and iodine, which are believed to possess the property of promoting the absorption of morbid products.

ABSORBENT VESSELS and GLANDS, Diseases of.—*See* LYMPHATIC SYSTEM, Diseases of; BRONCHIAL GLANDS, Diseases of; and MESENTERIC GLANDS, Diseases of.

ACARUS.—*Acari* or *mites* constitute an order of the class *Arachnida*, several species of which are parasitic. The *Acarus scabiei* or *Sarcoptes hominis*, and the *Acarus folliculorum*, or more properly the *Steatozoon folliculorum*, are the only human parasites belonging to this family.

DESCRIPTION.—1. The ACARUS SCABIEI is a small roundish animal, just visible to the naked eye. Examined under the microscope it is seen to be flattened, and to resemble a tortoise in shape; when fully developed it has eight legs, and on its under surface are scattered filaments and short spines, which are for the most part directed backwards. The female is larger than the male, and is provided with terminal suckers on the four anterior legs, while filaments occupy a similar position on the posterior ones; in the male, however, the two extreme hind legs have suckers like those on its fore limbs. The young *acarus* has only six legs, the two hindmost ones, which are distinctive of the sex, being wanting; it acquires these after shedding its first skin. The male *acarus* lives near the surface of the skin, while the female burrows within the cuticle, and deposits from ten to fifteen eggs in the cuniculus or burrow; these eggs hatch in about a fortnight. The young *acari* escape from the burrow, but the parent does not leave it, and dies when she has finished laying eggs. The *acarus scabiei* is the cause of the skin-affection termed *Scabies* or *Itch*. *See* SCABIES.

2. The ACARUS FOLLICULORUM is a very minute parasite commonly found in the sebaceous and hair-follicles of the face, but its presence can hardly be regarded as indicating disease. In this animal the head is continuous with the thorax, and to the latter are attached eight very short legs, each armed with three strong claws. On each side of the head are short jointed palpi. The abdomen varies in length from twice to three or four times that of the thorax; it is pointed at its distal extremity. The presence of this parasite in the follicles of the skin is quite unimportant. ROBERT LIVEING.

ACCOMMODATION, Disorders of. *See* VISION, Disorders of.

ACEPHALOCYST (ἀ, priv.; κεφαλή, a head; and κύστις, a bag).—A headless cystolar hydatid; a sterile hydatid. *See* ENTOZOA—Hydatids.

ACHOLIA (ἀ, priv.; and χολή, bile).—Absence or deficiency of bile. *See* BILE, Disorders of.

ACHOR.—A small follicular pustule of the scalp. Willan's definition is as follows:—'A small acuminated pustule containing a straw-coloured matter, which has the appearance and nearly the consistence of strained honey, and is succeeded by a thin brown or yellowish scab.' Both the pustule and the scab are constituents of the disease *porrigo*. The word has fallen into disuse, but is preserved by Schönlein in the name 'achorion' assigned by him to one of the varieties of parasitic cutaneous fungi. The Greek word ἀχώρ signifies scurf, or dandruff; ἀχυρόν meaning chaff. ERASMUS WILSON.

ACHORION (ἀχώρ, scurf) is the name given to one of the three principal dermophytes or epiphytes of the skin. It is the constituent of the crust of favus (achor), and belongs to the group of fungoid plants denominated *Oïdium*. It consists of spores, sporidia or tubes filled with spores, and empty branched tubes or mycelium.

Achorion was the first discovered of the epiphytes of the skin, and in compliment to one of its early observers, Schönlein, has been named *Achorion Schönleinii.* It is supposed to be the agent of contagion in favus; it has also been found in the loose cell-structure beneath the nail in onychogryphosis.

Erasmus Wilson.

ACHROMA (ἀ, priv.; and χρῶμα, colour). Absence of colour; an achromatous or colourless state of an usually coloured tissue, due to absence of pigment. In reference to the skin, achroma is synonymous with leucoderma, albinism, and alphosis. *See* Pigmentary Skin-Diseases.

ACHROMATOPSIA, (ἀ priv.; χρῶμα, colour; and ὤψ, sight).—More or less complete inability to distinguish colours from each other. *See* Vision, Disorders of.

ACIDITY.—Acids are constantly passing out of the body by the lungs, the skin, and the kidneys. These acids, if we except the small quantity introduced from without in the form of acid salts of certain articles of food, are formed within the body by the disintegration and oxidation of the tissues and food. If the oxidation of organic substances in the system were complete, the sole products of their combustion would be carbonic acid, water, and urea; but as this oxidation is never actually complete, other products, as lactic acid, oxalic acid, uric acid, &c., are formed; and the increased or diminished production of these intermediary products may be regarded as the measure of the completeness with which the oxidation processes are being performed in the body. The quantity of acid matter passing through the blood on its way to the lungs, the skin, and the kidneys is considerable; since it has been shown approximately, that a healthy man of eleven stone weight, under ordinary circumstances, passes by the first two channels an average of 890 grammes (about 28 ounces) of carbonic acid daily, and that the acid excreted by the kidneys in the same period is equivalent to two grammes (about 31 grains) of crystallised oxalic acid; whilst the volatile fatty acids passing off with the sweat have not yet been satisfactorily calculated. It is evident that if the regular elimination of acids, by any of these channels, be interfered with, they will tend to accumulate in the system. Acidity, or excess of acid in the body, therefore depends on two causes:—1. *excessive formation*, the result of incomplete oxidation of the elements of the tissues and the food; 2. *deficient elimination* of acid formed either in normal or abnormal quantities. Both these causes, however, are generally found acting in conjunction. Oxidation is imperfectly performed when an insufficient quantity of oxygen is introduced into the body, owing to insufficiency of the respiratory act, the result of disease or sedentary habits; or when the blood is poor in red corpuscles, the carriers of oxygen, as in leukæmia; or from functional derangement of some large gland, such as the liver, where oxidising processes are extensively carried on. Again, the materials submitted to the influence of the oxygen within the body may be so increased, as is the case in febrile conditions, or in general plethora induced by over-feeding and insufficient exercise, that the supply of oxygen may prove insufficient for their complete combustion. Defective elimination of the acids formed within the body is due either to diseased conditions which prevent the lungs, skin, and kidneys from exercising their respective functions properly, or to want of the physiological stimulus which excites them. It will be seen, therefore, that acidity may arise in consequence of the disturbing influence of disease; or may be acquired or inherited as the penalty of transgression of certain laws of health—as the result of unfavourable hygienic conditions. In the former case, acidity is only secondary, and is generally subordinate to the disease producing it, and has rarely to be considered apart from it; whilst in the latter instance acidity is usually at first the only trouble, leading, however, if disregarded to secondary mischief.

Effects.—The mucous membranes and skin chiefly suffer in acidity. The former become subject to catarrh, produced, no doubt, by the irritating presence of the acid. Acidity may thus cause bronchitis, gastro-intestinal catarrh, and catarrh of the genito-urinary tract. Sometimes the acid is poured out in such quantities from the mucous membrane of the stomach as to be ejected from the mouth. In these cases digestion is considerably interfered with by the too acid condition of the gastric juice. Sometimes, however, this acidity of the stomach is produced by an opposite condition—the deficiency of the digestive fluid, and consequent acid fermentation of the food. Abnormal acidity of the urine not only produces catarrh of the urinary passages, but by decomposing the salts of uric acid causes a deposit of insoluble uric acid in the passages, thus giving rise to attacks of gravel, or leading to the formation of a calculus. Acidity manifests itself in the skin by attacks of erythema, herpes, eczema, and urticaria. Rheumatism, too, may be considered as a disease resulting from the formation of acid, affecting chiefly fibrous and serous membranes; no one can witness the enormous quantities of acid sweat poured out, and the highly acid urine, in the acute form of this disease, without acknowledging that an increased formation of acid is taking place somewhere in the body; though perhaps unwilling to commit oneself to accept any of the views hitherto advanced as to the nature of the acid.

Estimation of Acid.—For clinical purposes an estimation of the acidity of the urine furnishes the physician with an approximate clue as to the amount of acid formed in and passing out of the body. This is done by collecting the urine for twenty-four hours, placing 100 c.c. of this in a beaker, and then adding a solution of sodium hydrate (standardised so that 1 c.c. = ·01 gramme of crystallised oxalic acid) from a Mohr's burette, till the fluid is neutralised. The number of c.c.'s of the standard solution required to effect this is to be multiplied by ·01, which gives the percentage acidity in terms of oxalic acid. To ascertain from this the total amount of acid in the twenty-four hours' urine is only a matter of calculation. Too much dependence must not, however, be placed on the urine as a means of estimating excess or deficiency of acid in the system; it sometimes happens that in highly acid conditions the urine is alkaline. This, as Dr. Bence Jones has shown, may occur when large quantities of acid fluid are poured out of the stomach; and Prout long ago observed, that in the eczema of gouty persons, the urine, so long as the disease persisted, was either of low acidity or alkaline, but that the subsidence of the eczema was frequently followed by an over-acid condition of the urine, accompanied with renal and vesical catarrh.

Treatment.—The general indications for the treatment of acidity consist in the promotion of oxidation, and the elimination of the acids formed. Active habits, which promote the pulmonary and cutaneous functions, should be encouraged. The diet should be just sufficient to meet the physiological requirements of the body; it should consist chiefly of fish, fowl, game, and eggs; saccharine and farinaceous articles being excluded. Sweet and cheap wines should be avoided; for those who cannot afford to purchase good wine, pure spirits and water is the best substitute. Carlsbad salts or Friedrichschall water may be given if there is much abdominal plethora; the habit of taking mercurials as a relief for this condition is to be deprecated. Alkaline medicines are frequently administered with a view of neutralising the effects of acid; their employment for this purpose seems, however, questionable. The late Dr. Parkes stated that the administration of bicarbonate of potassium (a favourite remedy in acid diseases), though rendering the urine alkaline, in reality increases very largely the excretion of the organic acids. This is not to be wondered at when we consider that the bicarbonate, although alkaline in reaction, is in constitution an acid salt. Dilute nitric and hydrochloric acids, given in moderate doses about one hour before meals, certainly have a powerful oxidising effect, and diminish the quantity of uric acid excreted in the urine. In cases where the acidity is manifestly due to defective oxidation, consequent on poverty of blood from diminution of the red corpuscles, iron and food must be freely given. C. H. Ralfe.

ACIDS.—Definition.—Substances which combine with alkalis, and destroy their power of turning red litmus-paper blue. Most of the acids also redden blue litmus, and have a sour taste; but some—for example, carbolic acid—possess neither of these properties.

Enumeration.—Acids may be divided into *inorganic* or *mineral*, and *organic*. The mineral acids used in medicine are Boric, Carbonic, Chromic, Hydrochloric, Hydrobromic, Nitric, Nitro-hydrochloric, Phosphoric, Sulphuric and Sulphurous acids. The organic acids thus employed include Acetic, Benzoic, Carbolic, Carbonic, Chrysophanic, Citric, Gallic, Hydrocyanic, Lactic, Oleic, Salicylic, Tannic, Tartaric, and Valerianic.

Action.—The stronger acids—sulphuric, nitric, hydrochloric, chromic, glacial acetic and lactic acids—destroy animal tissues, and act as caustics when applied to the surface. When swallowed they produce the symptoms of irritant poisoning (*see* Poisons). An antidote for these poisons which is always at hand is carbonate of lime, in the form either of whiting or of plaster chipped from the nearest wall. Other antidotes are alkaline carbonates and bicarbonates, milk, oil and soap. Diluted acids, taken into the mouth, increase the secretion of saliva; and hydrochloric acid forms an important constituent of the gastric juice, without which digestion does not go on. When absorbed into the blood, dilute acids act on the heart generally, slowing its pulsations and reducing the temperature. They are excreted in the urine and milk.

Uses.—Nitric acid is employed as a caustic application to piles, to poisoned wounds, and to spreading or unhealthy sores. Glacial acetic acid is used to destroy corns or warts. Diluted acetic acid or vinegar is applied as a lotion to relieve headache; to allay the itching of prurigo, lichen, and psoriasis; to check perspiration; and sometimes to hasten the appearance of exanthematous eruptions. Diluted acids, especially citric, tartaric, and hydrochloric, as well as acid tartrate of potassium, are administered in fevers as refrigerants, because they relieve the dryness of the mouth, and diminish the thirst by increasing the secretion of saliva, as well as lower the temperature and pulse-rate. Under the like circumstances, the organic acids, acetic, citric, and tartaric, when combined with alkaline carbonates in a state of effervescence or otherwise, form compounds which act on the skin and kidneys. In febrile conditions, anæmia, and some forms of dyspepsia, the proportion of acid in the gastric juice is insufficient for the proper digestion of food, and the administration of dilute hydrochloric acid, immediately before or after meals, is useful both by aiding digestion and by preventing the formation of butyric and other acids, which give rise to sour eructations. Nitro-hydrochloric acid, before meals, is likewise beneficial in preventing acidity. It appears to have some action on the liver; and is used, both internally, and externally as a lotion or footbath, in jaundice and biliousness. It generally relieves the frontal headache common in young women, which is felt just above the eyebrows, and not accompanied by constipation. Dilute acids, especially aromatic sulphuric acid, are useful in checking diarrhœa, colliquative sweats, hæmorrhages, and mucous discharges. By lessening the alkalinity of the urine, they tend to prevent the formation of phosphatic calculi; phosphoric, nitric, and lactic acids being most frequently employed for this purpose. Care must be exercised in their administration to nursing mothers, as they are excreted in the milk, and sometimes cause griping and diarrhœa in infants at the breast. Several acids have a special action of their own, and are considered under their respective groups, such as hydrocyanic and hydrobromic acids, which are sedative; boric and carbolic, antiseptic; chrysophanic, parasiticide; salicylic, antipyretic: gallic and tannic, astringent.

T. Lauder Brunton.

ACINESIA.—*See* Akinesia.

ACIREALE, in Sicily.—Cold sulphur waters, and climatic health-resort. *See* Mineral Waters.

ACNE.—Synon.: *Acne vulgaris; Acne adolescentium; Acne disseminata;* Fr. *Acmé; acné*; Ger. *Acne.*

Definition.—A chronic disease of the skin, confined to the face, back, shoulders, and chest. The eruption is met with in young adults, and consists of pimples, which are caused by an inflammation of the sebaceous glands and hair-follicles. The disease leaves small depressed scars.

Ætiology.—The ætiology of acne is obscure. It is seldom met with before puberty, and is usually fully developed at about the age of eighteen or twenty, and then gradually disappears before the age of thirty. There are, however, many exceptions to this rule, especially in men, who are liable to a severe form of acne of the shoulders and back, which may continue until middle life. Acne appears to be equally common in males and females, and is especially met with in those who have what is called a slow circulation in the extremities—that is, who suffer from cold hands and feet, and perhaps chilblains. In accordance with this, the disease often improves, or even disappears, during warm summer weather, to return again in the following winter.

Symptoms.—Common acne is a pimply eruption, met with chiefly on the face and shoulders, less often on the back and chest. Many of the pimples are of a pale colour with a small dark centre, and consist simply of follicles, over-distended with sebum, the black centres marking the orifices of the follicles. These pale little papules, called *comedones*, are apt to become red and inflamed, thus forming the ordinary acne pimple, which ultimately suppurates, and discharges a minute quantity of pus; the spot then heals, leaving a small scar. In all severe cases of acne we find, in addition to the ordinary acne spots, larger pimples, resembling blind boils, which suppurate slowly, and often leave very ugly scars. Acne develops in successive crops, so that, as one set of pimples dies out, others appear, and thus the disease becomes chronic. Acne is almost always distributed symmetrically, so that both sides of the face and back are pretty equally affected. The exceptions to this rule are very rare.

Diagnosis.—The differential diagnosis of acne is usually easy when the symmetrical distribution of the eruption, and its period of development, are taken into consideration. The two eruptions with which it is most likely to be confounded are: (1) certain forms of acne rosacea (gutta rosea), and (2) acne-like dermato-syphilis. Acne may best be distinguished from acne rosacea by the fact that this latter disease is chiefly met with in middle life, and is always attended with more or less general congestion of the face, and the subjective sensations of burning or tingling—characters which are absent in common acne. Acne rosacea is exclusively confined to the face, while common acne attacks also the shoulders and back.

Acne-like syphilitic eruptions are best distinguished by the absence of comedones; and by the tendency the pimples have to form into groups, which are not always symmetrical, and not strictly confined to the acne regions. Some other syphilitic symptoms would probably be also present.

Varieties.—There is an interesting eruption, commonly called *acne varioliformis*, which requires a very brief notice. In general appearance the pimples resemble those of acne, but are not especially associated with comedones. The eruption is usually confined to the scalp and upper part of the forehead. The scars formed by this disease are much deeper than those of common acne, and very closely resemble the pits left by small-pox. The region affected and the character of the scars are a sufficient guide to diagnosis.

Treatment.—As acne arises, for the most part, from the formation of comedones and plugging of the follicles, the treatment should be directed to stimulating the sebaceous glands of the skin to action. For this purpose the application of sulphur is most useful. The sulphur may be applied in the form of an ointment or lotion. The objection to a lotion is, that during the night the powdered sulphur is apt to get into and inflame the eyes a little. There is not, however, the same objection to the use of a sulphur lotion during the day-time. A good plan is to apply a mild sulphur ointment or Wilson's hypochlorite of sulphur ointment every night, and wash it off in the morning with hot water, soap, and a soft flesh-brush. The daily use of a soft flesh-brush with hot water and soap is especially beneficial, as it prevents the formation of comedones.

When sulphur does not produce the desired effect, the linimentum saponis should be applied every night and allowed to dry on, and be washed off in the morning with warm water. In very severe cases of acne, there are always a certain number of boil-like spots, which suppurate very slowly, and sometimes last for months without coming to a head. These boils should be carefully touched with a small piece of wood dipped in pure carbolic acid, or a saturated solution of potassa fusa in water; or the acid nitrate of mercury solution may be used, great care being taken that only the top of the boil is touched with the caustic. Cod-liver oil is the most generally useful tonic in cases of acne, but other tonics are occasionally beneficial. Robert Liveing.

ACNE ROSACEA.—Synon.: *Gutta rosea*; Fr. *Couperose*; Ger. *Das kupfrige Gesicht.*

Definition.—A chronic congestion of the face, attended with sensations of burning or stinging, and leading to a permanent enlargement of vessels and the formation of pimples.

Symptoms.—There are two varieties of acne rosacea. The more severe form is met with chiefly in men, and is often the result of over-indulgence in alcohol. It especially attacks the nose, and leads to considerable enlargement of the vessels, and also, if of long standing, to hypertrophy of other parts of the skin, especially the sebaceous glands. The milder form of gutta rosea is very common in women after the age of thirty. In the first instance it may consist of a simple flushing of the face, coming on at certain periods of the day, as, for example, after meals or in the evening. This congestion has, however, a tendency to become more persistent; and then the vessels being permanently dilated, the redness does not entirely disappear, although it varies in degree from time to time. Gutta rosea in women is not confined to the neighbourhood of the nose, but usually extends in a butterfly-shaped patch to both cheeks, and sometimes to the forehead and chin. It is always attended with subjective sensations, which are generally those of burning, and less frequently of stinging or itching. Acne-like pimples are only occasionally met with, and when present are due to follicular inflammation.

Ætiology.—Gutta rosea in women is for the most part associated with cold hands and feet, and not uncommonly with dyspepsia and constipation, or irregularity in menstruation. In men, as before stated, the hypertrophic variety is sometimes, but by no means always, caused by over-indulgence in alcohol.

Treatment.—The severer form of gutta rosea, in men, is best dealt with by: (1) abstinence from alcohol; (2) the longitudinal division of the enlarged veins with a lancet; and (3) the subsequent daily use of sulphur ointment, which should be well rubbed on every night. Great hypertrophy of the nose (lipoma nasi) can only be removed by means of the knife. In treating gutta rosea, as it is commonly met with in women, the following points require special attention. (1) The diet should be carefully regulated, and medicines ordered to remove, as far as possible, any dyspepsia or any menstrual irregularity that may exist, and also to regulate the bowels, which are often constipated. (2) A very mild sulphur (or hypochlorite of sulphur) ointment should be applied in a small quantity every night, and washed off in the morning with warm, soft, oatmeal-water. In the daytime, a calamine and oxide of zinc lotion should be applied, and a little allowed to dry on. Gutta rosea is difficult to cure, but a steady perseverance in a rational plan of treatment will always produce a marked improvement in the disease, and sometimes quite remove it. Robert Liveing.

ACONITE, Poisoning by.—Synon.: Fr. *Empoisonnement par l'Aconit*; Ger. *Eisenhutvergiftung.*—The common garden-plant, *Aconitum napellus*, known also as 'wolfsbane' or 'blue-rocket,' as well as other species of aconitum, are poisonous, and owe their poisonous properties to the presence of an alkaloid, *aconitine* or *aconitia*, or perhaps to a mixture of alkaloids passing under this name. The same or similar alkaloids have been obtained from the Indian aconite, *A. ferox*, and from Japanese aconite roots. All parts of *A. napellus* are poisonous. Aconitine is perhaps the most poisonous alkaloid known. All parts of the aconite plant when chewed, and aconitine when placed upon the lips or tongue, produce, after a few minutes, a disagreeable acrid burning sensation, followed by numbness, loss of sensibility of the part, salivation, and an after-sensation of searedness. These sensations may last for several hours.

The fresh root of aconite has frequently been eaten in mistake for horse-radish, to which it bears a remote resemblance. The root of horse-radish is whitish on the exterior, is long and of fairly uniform diameter, has a pungent odour when scraped, and the scraped surface retains its white appearance; whereas aconite root is brown and conical, is destitute of pungent odour, and speedily acquires a pink colour when scraped and exposed to the air. Mistakes more frequently occur from liniments containing aconite being swallowed in error. In two cases the root has been administered with homicidal intent; and in one case a young man was killed, by the administration of, as it is supposed, two grains of English aconitine. Accidents have also arisen from the administration of the potent English aconitine in mistake for the impure inert exotic or German alkaloid, or mixture of alkaloids passing under that name.

Anatomical Characters.—After poisoning by aconite there may be gastric congestion or inflammation; but these may be absent.

Symptoms.—When aconite. or any of its preparations, is taken by the mouth, the first sensation, transitory and mainly due to the action of the solvent, is followed in about three minutes by an intolerable burning and numbing pain, extending from the place of application to all the surrounding parts of the mucous membrane. There is salivation; and the burning sensation extends down the gullet to the stomach. Occasionally, when the poison has been rapidly swallowed, no marked symptoms may supervene for half an hour. The general symptoms are very varied, but may all be referred to weakening of the heart's action, disturbances of respiration, and paralysis of sensation on the surface of the body. This last may be described as 'numbness' or 'drawing of the skin,' or by some equivalent term. There is pain in the epigastrium, violent vomiting, occasionally purging; the pulse, at first rapid, quickly diminishes in frequency and force till it is imperceptible; the skin is cold, clammy, and livid; respiration is laboured. The pupils, at first contracted, afterwards dilate; and this dilatation sometimes occurs suddenly and transitorily, and is accompanied by blindness. Convulsions are not common; but vomiting is often due to spasmodic contraction of the diaphragm, causing frothing at the mouth. Consciousness is retained till near the end of life.

Diagnosis.—The peculiar sensation in the mouth—burning, feeling of searedness, numbness, &c., the great cardiac depression, and the difficulty of respiration, will generally serve to determine the nature of the case.

Prognosis.—Death usually occurs within four or five hours. If the patient survive twelve hours, recovery is usually rapid and complete.

Fatal dose.—Of the *root*. sixty grains—probably much less might suffice. Of the pharmacopœial *tinctura aconiti* (1 in 8), two or three fluid drachms. *Fleming's tincture* is about six times as strong as the official tincture, and twenty-five minims have proved fatal. Four grains of the *alcoholic extract* have proved a fatal dose. English *aconitine* or *aconitia* (the alkaloid) is terribly potent: 1-2000th grain will produce a very decided sensation on the tongue, and it is probably as poisonous as the crystallised French aconitine-nitrate, one-sixteenth of a grain of which has killed an adult within five hours.

Treatment.—In proceeding to treat a case of poisoning by aconite we must, first, wash out the stomach by means of the stomach-pump, and promote vomiting by warm emetics, of which carbonate of ammonium is the best. Stimulants must be freely administered; also strong black coffee or tea. Brandy and ether may be injected subcutaneously. Digitalis is a counter-poison, and may be administered with effect subcutaneously, in doses of twenty minims of the tincture, repeated in an hour or so if necessary. Inhalations of nitrite of amyl may afford some relief. The patient must be kept strictly in the recumbent position, warmth being applied to the surface; and, as a last resort, artificial respiration must be used. *See* Poisons. Thomas Stevenson.

ACQUI, in the Province of Alessandria, Italy.—Thermal sulphur waters. *See* Mineral Waters.

ACQUIRED DISEASES.—Diseases which originate independently of hereditary transmission. *See* Disease, Causes of.

ACROCHORDON.—An outgrowth of the integument in the form of a slender cylinder, which may be compared to the loose end of a piece of string or cord—ἄκρον signifying a point or end, and χορδή a string. Such outgrowths are usually met with in a feeble state of the skin, and particularly in elderly persons, their common seat being the neck or trunk. They are at first sessile, but become elongated; and are sometimes bulbous at the extremity, and more or less pedunculated. Microscopically, an acrochordon is composed of loose areolar tissue, firmer at the surface than within, and of a fine artery and vein, connected by a capillary loop or plexus, and sometimes a little ramified. It is popularly regarded as a wart, and in medical works is termed *verruca acrochordon*, but it differs from a wart very widely in structure.

Treatment.—This consists in snipping off the outgrowths with scissors, or touching them with a strong solution of potassa fusa (equal parts). When numerous and minute, they admit of being shrivelled up and removed by means of liquor plumbi subacetatis, or a lotion of perchloride of mercury, two grains to the ounce. The latter, possibly by its stimulating property, also arrests their formation.

Erasmus Wilson.

ACRODYNIA (ἄκρος, extreme; and ὀδύνη, pain).—This disease was epidemic in Paris in 1828, and was described by Alibert as a dermatitis affecting the hands and feet, particularly the palms and soles, accompanied with burning heat, stinging and smarting pains, and numbness. The pains sometimes extend to the whole system, and there is more or less disorder of the digestive and assimilative functions. The redness is at first bright, then deeper tinted and brown, with considerable pigmentation of the rete mucosum. Occasionally there are pimples, pustules, and blisters; the cuticle desquamates, and is sometimes cast in a single piece; the disease running on for several weeks.

Treatment.—This should be directed to the regulation of the digestive and assimilative organs; and to the relief of local inflammation by means of water-dressing, followed by the application of zinc ointment and a bandage.

Erasmus Wilson.

ACROMEGALY (ἄκρον, an extremity; and μέγας, large).—Synon.: Fr. *Acromégalie.*

Definition.—A remarkable dyscrasia, the striking characteristic of which is an enlargement of the bones, and most obviously of the bones of the hands and feet. Hence the name applied to it by Marie, who first described the disease in 1880, though other cases had been noted previously under different titles.

Pathology.—Acromegaly occurs most frequently, but not exclusively, in females between the ages of thirty and forty, but has been observed as early as fifteen and as late as forty-eight. It is very chronic; and though probably often fatal, it sometimes appears to become arrested after advancing for some years. In females it is usually preceded by early stoppage of the menses. Its relation to rheumatism is very doubtful.

Acromegaly is generally associated with enlargement or atrophy of the thyroid body; and enlargement of the thymus gland has been observed. In three post-mortem examinations tumours of the pituitary body have been met with.

Description.—In this disease the bones of the hands and feet are very greatly enlarged, but the long bones do not escape, the natural prominences and elevations being exaggerated sometimes to the dimensions of exostoses. The scapulæ, clavicles, and the sternal ends of the ribs become quite massive; the lower jaw also assumes vast proportions, the lower teeth spreading out and projecting far in front of those of the upper jaw. This gives a characteristic appearance to the face, which is that of an egg with the large end downwards, as opposed to the oval of myxœdema, and the inverted egg shape of osteitis deformans, with both which diseases acromegaly may be confounded. The upper jaw and the cranial bones occasionally participate in the change. The bones, though enlarged, do not become curved; but the spine is often bent, so that the patient loses considerably in stature.

The cartilages of the nose, ears, eyelids, and larynx may be thickened; the last change probably accounting for an occasional great alteration in the voice.

The subcutaneous tissues are not obviously altered. The skin may be unchanged, but on the face it is apt to become coarse, and to show clearly the orifices of the sweat-glands. The hair does not become thin, as in myxœdema. Profuse perspiration and thirst are generally present.

The tongue is enlarged, and taste may be much impaired. Blindness is not uncommon, from atrophy of the optic nerve, possibly connected with a pituitary tumour. The sense of smell is often impaired; that of hearing does not appear to be modified, nor does that of touch.

There may be shortness of breathing, depending upon asthmatic attacks, and the heart may be hypertrophied. The urine is not usually abnormal. The temperature is not raised. The intellect remains perfect.

Diagnosis.—It is not necessary to indicate the difference between this disease and osteitis deformans or myxœdema—practically the only two with which it can be confused, because, though there is certainly a superficial resemblance to each, the points of divergence are wide. The symptoms have been stated somewhat dogmatically for the sake of brevity; and, as only a few cases have as yet been accurately observed, it is probable that some of those here set down may be found to be incorrect or not characteristic.

Treatment.—None of the numerous methods of treatment hitherto applied in acromegaly have proved of the slightest use.

Rickman J. Godlee.

ACTINOMYCOSIS (ἀκτίς, a ray; and μύκης, a fungus).—Definition.—A chronic disease, attended by the formation of abscesses, chronic interstitial inflammations, or tumour-like growths of granulation-tissue, due to infection by a fungus known as *Actinomyces bovis.*

History.—This disease, which especially affects horned cattle and swine, and has long been known under various names as occurring in them, has during the last few years been proved to be not infrequent in man. Its parasitic nature was discovered in 1876 by Bollinger, who named the parasite *Actinomyces*, the ray-fungus. In 1877 J. Israel, and in 1879 Ponfick, described cases in the human subject, and showed their identity with the animal disease. Since that time numerous instances of the disease have been observed; with chronic abscesses, especially in the liver, lungs, bones and periosteum, intestinal canal—especially the large intestine—and more rarely in other positions, *e.g.* in the brain, as in recent cases recorded by Dr. Delépine and others.

General Characters of the Disease.—In the lower animals actinomycosis frequently produces indurated masses of connective-tissue growth, which tend to become calcified; hence the name 'woody tongue' applied to the affection in cows. In man there is a tendency rather to the formation of chronic abscesses. Infection usually appears to occur by the alimentary canal or air-passages, the virus entering through carious teeth, the crypts of the tonsils, pharynx, &c., or more rarely by direct aspiration into the lungs. Most commonly it tends first to produce destructive changes, for example, in the jaws (upper and lower), the wall of the pharynx, or the mucous membrane of the alimentary canal. In the jaws a process of gradual necrosis may occur. From the upper jaw it is apt to spread to the periosteum in front of the vertebræ, or to the base of the skull, leading to chronic periosteal abscesses, followed by caries, sometimes with retro-pharyngeal abscess. It may next invade the tissues of the neck, forming deep-seated abscesses. Not infrequently in man, however, the liver is the first organ obviously attacked. It has been shown that a primary infection of the mucous membrane of the intestines, especially the large intestine, may occur, and not improbably the infection of the liver is secondary to this. Affection of the lungs may take place by direct aspiration of the virus, or possibly through infection extending from the mediastinum, which has been reached through the œsophagus. Infection of the brain and other parts may take place either through the lymphatics or through the blood.

Anatomical Characters.—Four varieties of the chronic inflammatory process have been determined in actinomycosis:—

First, when upon a free surface, as the mucous membranes, the formation of masses of epithelium containing the fungus has been observed, together with subjacent ulceration.

Second, when occurring upon a free surface, as in serous cavities or within the periosteum, tumour-growths may occur, formerly mistaken (when periosteal) for osteo-sarcomas.

Third, the formation of masses of dense granulation-tissue or sarcoma-like tumours, which may become fibroid or calcified, but remain indurated. Allied with this there may be an infiltration with firm granulation-tissue.

Fourth, the production of chronic abscesses, which soften slowly, causing widespread infiltration and necrosis of the tissues, but are not usually accompanied by marked inflammatory reaction. In the pus from these abscesses, which is usually thick, yellow, and somewhat lumpy, may be found minute yellowish granules or masses, varying in size from the most minute particles visible with the naked eye, to the size of about $\frac{1}{20}$ inch in diameter, of yellowish colour, ovoid or rounded, and of slightly greasy feel. Under the microscope these are found to consist of masses of the ray-fungus.

On microscopical examination of prepared sections, especially in the firmer nodules, the characters can be better seen. Various modes of staining may be employed, for which the reader is referred to special technical works, gentian-violet, fuchsin, and methylene blue being amongst the most suitable reagents. The structure is composed of granulation-tissue, either small or large-celled, frequently with branching and spindle cells, resembling spindle-celled sarcoma. Scattered through the granulation-tissue are deeply stained masses, which form the centre of more typically arranged masses of cells. The fungus itself, when seen in the smaller nodules, is usually composed of a central

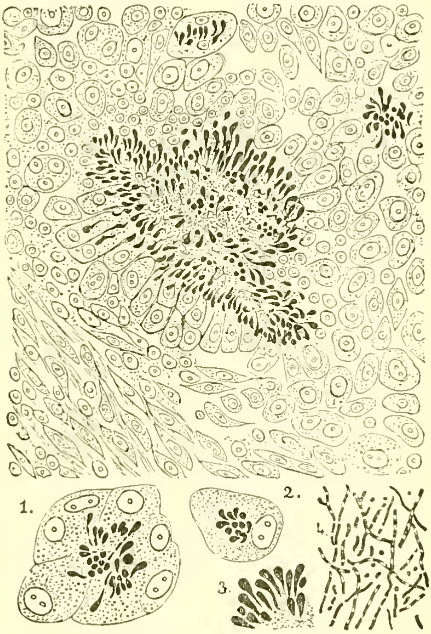

Fig. 1.—The wood-cut shows the characters of a minute centre of growth in an actinomycosis nodule from the tongue of a cow. The upper portion is sufficiently described in the text. The mass of fungus is represented as much less dense than in reality, otherwise no detail could be shown. (Magnified about 800 diameters.)

The lower four small figures show the characters seen in the same growth under a somewhat higher power. (1) A group of cells (? one cell in a state of division) containing a cluster of the clubbed filaments. (2) A single cell with actinomyces growing in it. (3) A group of clubbed hyphæ much larger than the others. (4) Filaments from centre of mass, showing bacillus-like characters, and false branching; resembling cladothrix.

portion containing coccus-like bodies, and delicate, branching, bacillus-like filaments. At the periphery of the mass the filaments are arranged side by side and radially, their outer extremities being swollen and bulbous-looking or club-like. Immediately surrounding these a zone of large epithelioid granulation-cells may be observed, the cells sometimes being arranged radially and resembling columnar epithelium. Still further out are epithelioid cells in layers; and beyond these are smaller cells, gradually merging into the surrounding granulation-tissue. Considerable varieties of structure are, however, observed, which need not be detailed here. The epithelioid cells may be scanty, or irregularly arranged, and of small size. In general arrangement these centres recall somewhat that of an elementary tubercle-follicle. The masses of fungi also present varieties. When of large size they frequently show zones of calcification. Club-shaped bodies may also be found scattered more irregularly through the mass. The branching, delicate threads may be numerous or scanty; and masses of coccus-like bodies may be observed.

Much discussion, which it would here be undesirable to detail, has taken place as to the nature of the fungus, and the exact relations of its different forms. The general belief now is that it belongs, or is closely allied, to the *cladothriceæ*, and that the several forms are various stages of its growth, the coccus-like bodies being spores, the filaments the earlier stages of its growth, and the club-like bodies swollen filaments or *hyphæ*—swollen in consequence of defective nutriment; some regard them, however, as possibly *asci*. The fungus has been successfully cultivated by Bostrom, and in its general characters appears closely to resemble the *cladothriceæ*.

For further details reference may be made to special works.

Mode of Infection.—The general evidence at the present time renders it probable that the infection of actinomycosis is introduced by food, and especially by some varieties of grain on which the fungus grows. Grain grown on freshly cultivated ground has in some cases apparently led to an outbreak amongst cattle. In one case in the human subject, recorded by Soltmann, a child swallowed a head of wall-barley (*hordeum murinum*), which stuck in the œsophagus and was followed by the development of an actinomycotic abscess (Klebs, *Allg. Path.* 1887, p. 286). Direct transmission by contagion has been observed by Johne and Ponfick; and by inoculation of material from abscesses (Fleming, *Actinomycosis*, 1888; also Crookshank, *Med. Chi. Trans.* vol. lxxii. p. 207). Organisms similar to the actinomyces grow on various kinds of grass.

General Course.—Actinomycosis is usually extremely chronic. When primarily affecting the *lungs*, it tends to spread locally and involve the pleura, the periosteum of the ribs, and the tissues of the thoracic wall, forming sinuses which open externally. In some cases the fungus has been found in the sputum without definite physical signs in the lungs. In the *liver* the abscesses may also reach a considerable size, and tend to form adhesions and fistulous tracks through the abdominal wall. In the *neck*, as has been stated, a slow process of extension may take place to the base of the skull, the vertebræ and their periosteum, and the deeper tissues of the part, forming in some cases very large chronic abscesses, which when opened show little tendency to heal. Direct spread of the infection by the lymphatics has been observed, but the production of abscesses in the brain can scarcely be accounted for except by carriage through the blood-stream. The fungus, like other organisms, is frequently found, especially in the coccus and rod forms, within granulation-tissue cells and leucocyte-like cells in the local affection; and it is not improbable that these simpler forms may be carried throughout the body by wandering cells and leucocytes. The abscesses are sometimes unattended by fever, but abscesses in the lungs and liver have sometimes been accompanied by recurrent rigors.

Diagnosis.—This in many cases can only be determined by microscopical examination of the discharges or the pus. A very chronic slowly-spreading abscess-formation of undetermined cause should lead to suspicion of actinomycosis. The absence of fever cannot be relied upon. In the microscopical examination of the sputum care must be taken not to confound the fungus with very similar organisms which may occur in carious teeth, &c.

Treatment.—Little can be said on this subject. Complete evacuation of abscesses, and (where possible) irrigation with dilute antiseptic solutions, would no doubt be indicated. From our present knowledge it is improbable that any internal remedy could be safely given in sufficient doses to destroy the fungus. The general treatment must rather be directed to the nutrition and support of the vital powers of the patient.

W. S. Greenfield.

ACUPUNCTURE (*acus*, a needle; and *punctum*, a prick).—Synon.: Fr. *acupuncture*; Ger. *Nadelstich*.

Description.—Acupuncture is an ancient mode of treatment for the relief of painful affections, now but little used, consisting in the introduction of fine round needles through the skin, to a varying depth. It is said to have been introduced into this country from China or Japan, about 200 years ago. The needles used are about two inches in length, and are set in round handles, so that they can be introduced with a gentle, rotatory movement. Acupuncture is now employed chiefly in lumbago and sciatica, in which affections it undoubtedly may give relief. The operation is thus performed. The patient being laid upon his face, tender spots are sought for—in lumbago over the erector spinæ, in sciatica along the course of the sciatic nerve. The needles are then pushed in vertically for a depth of from one and a-half to two inches, and allowed to remain for from half an hour to two hours. The number of needles employed may vary from one to six. In sciatica it is recommended, if possible, to make the needle actually penetrate the nerve. This result is known by the patient complaining of sudden pain shooting down the back of the leg. The mode of action is uncertain, but in sciatica it has been supposed that the puncture of the nerve-sheath allows the escape of fluid. Acupuncture has also been employed in painful neuritis following injury, but without effect. In a modification invented by Baunscheidt, forty punctures, about half-an-inch in depth, were made in an area of the size of a crown-piece, by an instrument working by a spring. Oil of mustard, diluted with olive oil, was then painted on, which gave rise to an eruption like herpes. The term *acupuncture* is also applied by some to the introduction of needles into a cyst, in order to allow the fluid contents to escape, as in the treatment of ganglion, of hydrocele in infants, or of hydatid cyst of the liver. Puncture of the skin for the relief of œdema is sometimes called by the same name. For this purpose the ordinary three-cornered acupressure-needle is more convenient than a round acupuncture-needle, as the puncture resulting from it allows fluid to escape more readily. The number and situation of the punctures being determined upon, they should be made in rapid succession and of sufficient depth to allow a free escape of the fluid. MARCUS BECK.

ACUTE.—This word, when associated with a disease, signifies that such disease runs a more or less rapid course, and is generally attended with urgent symptoms. It is also employed to express intensity of a particular symptom, as, for example, pain.

ADDISON'S DISEASE. — SYNON.: *Morbus Addisonii*; Bronzed Skin Disease. Fr. *Maladie d'Addison*; Ger. *Addisonsche Krankheit.*

DEFINITION.—In his original memoir on this subject, Dr. Addison wrote: 'The leading and characteristic features of the morbid state to which I would direct attention are anæmia, general languor and debility, remarkable feebleness of the heart's action, irritability of the stomach, and a peculiar change of colour in the skin, occurring in connexion with a diseased condition of the suprarenal capsules.'

In reality, the general symptoms of the disease, as given above, outweigh in importance any pigmentary change whatever; and it is quite possible for the disease to run its course without any unusual deposit of pigment in any part of the body.

Addison's disease might, however, be defined as a constitutional malady, characterised by great weakness and anæmia, with deposit of pigment in the skin and some other parts of the body, depending on chronic tuberculosis of the suprarenal capsules, and the extension of fibrous thickening to the adjacent nerve-ganglia and plexuses, causing their compression and atrophy.

ÆTIOLOGY.—The constitutional or general nature of Addison's disease must ever be borne in mind, though some of its factors are strictly local; but, though constitutional, it is not transmissible either (*a*) by contagion or infection, or (*b*) by inheritance. If, however, Addison's disease itself is never an inherited malady, it is in very many cases associated with a highly hereditary constitution, that of the tubercular or scrofulous type; and in such individuals accidents, like falls or blows, which would fail to make an impression on stronger men or women, may suffice to set the morbid process in motion. In not a few instances the bodies of the subjects of this disease have been found perfectly healthy apart from the morbid change in the suprarenal capsules characteristic of the malady; and, in a certain number of cases, local abscesses seem to have been the starting-point of the specific changes in the capsules themselves. Addison's disease is, moreover, essentially one of early adult life, the great majority of cases occurring between fifteen and forty. It is much more frequent in men than in women; and seems to be in a great measure confined to the working classes.

SYMPTOMS.— The earlier symptoms of Addison's disease are often so indefinite and so insidious, that it may not be until the disease is fully developed that the patient seeks medical aid, and by that time they are usually unmistakable. It is different when the malady apparently originates in a fall or a blow; but even such a starting-point as this may only be sought for late in the history of the disease.

The mischief may be said to commence in most cases with a feeling of general weakness and of being unwell; the discolouration of the skin usually appears later, but may be the first prominent symptom. In a small number of cases the onset may be acute, with loss of appetite, sickness, headache, pain in the epigastrium, sometimes also vomiting and diarrhœa. When the disease has attained its full development, the characteristics of the malady are most striking. Then the downcast, mournful look, the drooping shoulders and stooping gait, the arms hanging helplessly by the sides, and the slow and listless movements of the patient are exceedingly impressive. If to this be added the darkening of the skin, the clear and pearly conjunctiva, and the breathlessness on exertion, we have almost all that meets the eye when such a patient presents himself. But to these, on inquiry, other important symptoms are easily added. The breathlessness will be found to be partly due to anæmia, partly to impaired innervation. From the same causes in part, but not entirely, we find a quick feeble action of the heart, readily giving place to palpitation. With these are usually associated pain and tenderness in the epigastrium and hypochondria, irritability of the stomach and nausea—giving rise to retching, and frequently obstinate vomiting. Such modifications of breathing as sighing, yawning, or hiccup, are frequent. Again, from the anæmia, there is a strong tendency to giddiness and syncope, which last increases as the disease wears on, and in many cases carries off the patient when raising himself or being raised in bed, for the purpose of taking food or performing other necessary functions. This is not the invariable mode of death, for nervous symptoms, such as coma or convulsions, may usher in the final scene. When the prostration is great, the patient may be for some time before death apparently unconscious, but this is simply due to unwillingness to make the slightest exertion, owing to his profound weakness.

Throughout the whole disease the bodily temperature is diminished (97°–98° Fah.) rather than increased; and this is often markedly the case towards the close of the disease, though then it has been noted as high as 100·8° Fah.

From the above sketch it is plain that the two most prominent factors in the disease, as presented during life, are:—

1. General weakness and anæmia.
2. Abnormal deposit of pigment in various parts of the body.

1. To the former of these is to be referred (*a*) the loss of muscular power, as evidenced by diminished muscular energy and force, both in the voluntary and involuntary muscles, for the heart's action is feeble and imperfect, and the bowels are usually confined. (*b*) At once a cause and consequence of the weakness and anæmia are loss of appetite, sickness and vomiting, though these, too, depend in part on other morbid changes; whilst, lastly (*c*), imperfect nutrition of the nervous system results, notably of the brain itself, whence arise vertigo, numbness, dimness of sight, deafness, tremors, and the like. The pain in the epigastric and hypochondriac regions is probably due to local causes.

2. The deposit of pigment is peculiar and characteristic. It is not uniform in disposition, and varies greatly in tint. It may only amount to a light brown or smoky discolouration in certain parts, or it may assume the appearance of a dark olive-green hue, approaching to black in some situations, especially over the genitals and nipples. Elsewhere it is most abundant on the face (where it often seems to begin), on the neck, the backs of the hands, the folds of the legs, and along either side of the linea alba. A striking peculiarity is that the conjunctivæ are clear and pearly, and that the nails are never discoloured. On the other hand, there is a great tendency to the deposit of pigment where the skin has been irritated or the epidermis removed, as by a mustard poultice or blister; but the skin is always smooth and supple. In a typical case under the writer's care, blisters had been applied to the chest for the uneasy feeling experienced there; and the pigmentary tint was deeper here than in any other part of the body, save the genitals. Cicatrices affecting the whole depth of the skin do not seem to be so pigmented. The mucous membrane of the mouth not infrequently becomes the site of pigmentary deposits. These are not diffuse; but, when the lips are affected, they usually take the shape of smears or lines. On the insides of the cheeks blotches or irregularly-defined spots are most common, as well as on the sides and root of the tongue. The latter spots are commonly better defined than are the others, and somewhat resemble the small well-marked black spots occasionally observed in parts already pigmented.

The site of this pigmentary deposit is in the growing layer of the epidermis, the usual site of colour in all races of mankind, and which is usually known as the *rete mucosum*; but occasionally pigmentary granules are to be found deeper, in the cells of the true skin.

An interesting clinical fact was brought out by the late Dr. Greenhow, which will, probably, be noted in a considerable proportion of cases. This is the mode in which the disease progresses. Often it presents periods of remission, only to be followed by a more marked advance; but, notwithstanding these remissions, the progress is invariably towards a fatal termination. The time occupied in this progress varies much: it may be weeks or months, or it may be years. But in all well-defined cases the result is the same.

PATHOLOGY.—From the earliest description of the morbid state known as Addison's disease, the malady has been associated with disease of the suprarenal capsules. At first it was supposed that any form of disease affecting these organs must give rise to a similar train of symptoms, and some of the investigations carried on with a view to sustain this position sound absurd enough by the light of subsequent experience. Gradually it has been made clear that only one kind of lesion is accompanied by the specific symptoms just detailed. Briefly, the morbid changes are as follows:

The suprarenal capsules normally consist of two parts, a cortical and medullary, differing greatly in their structure. In Addison's disease both are superseded by a new structure, which is to be seen in various stages. In the earliest of these the capsules are invaded by a kind of translucent material, which is sometimes almost cartilaginous in its hardness, and which, when examined under the microscope, resolves itself into a kind of very finely fibrillated or trabecular connective tissue, with corpuscles like leucocytes freely congregated in the interstices of the meshwork or between the fibres. This material, when seen in bulk, is grey or greenish-grey, afterwards becoming red on exposure. With it is mixed up an opaque yellow substance, varying in amount, and apparently more abundant the more advanced the disease. In the earlier stages it presents the appearance of nodules embedded in the translucent material, but later almost the whole of this material may have disappeared, and the yellow opaque matter become converted into a thick creamy fluid, a putty-like substance, or even one or more cretaceous masses. This opaque material, then, is evidently, from its first appearance, indicative of fatty degeneration, and closely resembles in every respect what used to be known as yellow or crude tubercle. The more recent discovery of the tubercle-bacillus in several cases confirms Virchow's original view as to the essentially tubercular nature of the affection.

The exterior of the capsules presents certain important features. The capsules themselves may be large or small, according to the stage of the disease and the nature of their contents, but, even when they are small, it may be safely assumed that at one time they were enlarged. In all cases they will be found closely and strongly adherent to neighbouring structures. Some of these structures are of great importance: for example, the semilunar ganglia, and the vast plexus of nerves associated therewith, in which important changes have been found. These pathological conditions have been so often observed and so carefully noted, that they cannot be looked upon as accidental concomitants of the diseased process, but rather part and parcel of it, and in all probability as giving a clue to some of the most marked phenomena of the malady. Broadly it may be said that these changes consist in a great thickening of the connective tissue surrounding the nerve-fibres and the ganglion-cells, giving rise to something like compression and ultimate destruction of these elements. This occurs both in the cerebro-spinal nerve-fibres, and in those more intimately connected with the ganglionic system. The nerve-cells, moreover, are not infrequently deeply pigmented.

The view commonly held as to the actual pathology of Addison's disease is that its phenomena are due to the nerve-lesions just described, and not to the destruction of the suprarenal capsules, though the exact mode in which they produce these effects is at present a mere matter of speculation. According to another view the destruction of the suprarenal bodies is the cause of the prominent symptoms, and this is supported by Dr. MacMunn, as the result of his spectroscopic observations on the blood and urine. He believes that the function of these bodies is to separate effete pigments and their accompanying proteids. When they are diseased, these elements are not removed, but circulate in the blood, the pigments or their incomplete metabolites producing pigmentation of the skin and mucous membranes, and appearing often in the urine as uro-hæmato-porphyrin; the proteids setting up toxic effects, and leading to further deterioration of the blood, with its consequences.

In making the section of the body after death from Addison's disease, one cannot help being struck with the amount of subcutaneous fat, especially over the abdomen, as contrasted with the difficulties of nutrition under which the patient suffered; yet a considerable quantity is almost always found. But more closely connected with this malnutrition are certain changes in the absorbent system along the digestive tract. These consist in enlargement of the solitary and agglomerated glands constituting Peyer's patches, and of the mesenteric glands; as well as in lymphoid growths in the mucous membrane of the stomach, which give rise to little projections, termed *mammillations*, on the walls of that organ, especially near the pylorus. Small ecchymoses are also not unusually found in the same situation. Of other organs it may be noted that the liver and spleen are often enlarged and hyperæmic, and the heart small and light in weight.

Diagnosis.—There would have been less difficulty or doubt in the diagnosis of Addison's disease, had it been clearly enunciated from the first that a bronzed skin did not alone constitute the malady. The disease rests on a threefold basis—*general weakness*, *diseased suprarenal capsules*, and *bronzed skin*, the last being the least important of the three. There may be darkening of the skin from a great variety of causes, viz.: (*a*) exposure, and attacks of vermin (*morbus erronum*, Greenhow; *Vagantenkrankheit*, Vogt); (*b*) wasting diseases, as chronic phthisis; (*c*) syphilis; (*d*) malaria; (*e*) liver-disease or jaundice if long-continued; &c.; but in none of these cases should there be any difficulty if the preceding dictum is borne in mind.

Prognosis.—This is always unfavourable, but it is impossible to assign any definite period for the termination of the disease, since it often progresses irregularly, with periods of improvement followed by relapse.

Treatment.—From what has just been said, it is plain that not much is to be effected by treatment as regards the cure of Addison's disease; but much may be done by careful management to retard its progress and comfort the patient. As soon as the disease is discovered, the sooner the patient makes up his mind to an invalid life the better. Rest and careful dieting are the basis of the treatment. As regards diet, it may be briefly said that what the patient can take best suits best. As the stomach is so irritable, anything likely to upset it should be avoided. Hence, as a rule, it is better to give concentrated nourishment, as essence of meat (*not the extract*) or chicken, or raw pounded meat, when other things cannot be taken. It is also important to bear in mind that the stomach will often tolerate food cold or even frozen, when hot substances would be promptly rejected. In certain stages of this malady it may well be said that the physician's success will depend more on his knowledge of the cookery book than of the Pharmacopœia—not, however, that our pharmaceutical gifts are to be despised. For the profound depression stimulants will be necessary, but these may take the shape of ether, or spirit of chloroform, as well as of wine or brandy. For the irritable stomach, alkalis, with nux vomica and ipecacuanha, or calumba, are of great service. So, too, in another way, are light tonics and neutral salts of iron; but the stomach should not be clogged with too much medicine. The bowels should not be much disturbed, but, if an aperient be required, a mild one, as a small dose of castor oil, or the compound liquorice powder of the Pharmacopœia, will suit. If the stomach rebel against these, a wine-glassful of Hunyadi Janos water the first thing in the morning, followed by a cup of warm milk, may better agree with the irritable organ. When there is diarrhœa, a totally different line of treatment will be necessary. But in all things, and at all times, the grand rule is to save the patient's strength, to add to it if possible, and to resist the inroads of the disease, whatever shape these may assume. Alexander Silver. W. Cayley.

ADENALGIA (ἀδὴν, a gland; and ἄλγος, pain).—Pain in a gland.

ADENITIS.—Inflammation of a gland. *See* the several glands.

ADENOCELE (ἀδὴν, a gland; and κήλη, a tumour).—A tumour connected with a gland.

ADENODYNIA (ἀδὴν, a gland; and ὀδύνη, pain).—Pain in a gland.

ADENOID (ἀδὴν, a gland; and εἶδὸς, form).—Glandular: resembling the structure of a gland, whether secreting or lymphatic.

ADENOMA (ἀδὴν, a gland, and the termination *oma*, adopted to indicate a tumour).—A morbid growth, the structure of which is of glandular nature. *See* Tumours.

ADHERENT. ADHESIONS.—Structures are said to be *adherent* when they become abnormally united together, the morbid formations by which this union is effected being termed *adhesions.* These are most frequently met with in connexion with serous surfaces, being usually the result of an inflammatory process, but they may be observed in other structures. The adhesions vary considerably in extent, number, mode of arrangement, firmness, and other characters: they may merely consist of a few loose, slender, and delicate bands; or these bands may be thick and strong; or the contiguous surfaces may be blended and matted together to a greater or less extent, so that they cannot be separated without tearing or cutting them asunder, this last condition constituting *agglutination.* In structure adhesions consist mainly of connective or fibrous tissue, more or less perfectly developed, with a few new vessels.

Effects.—Adhesions are often found at post-mortem examinations, which have been of little or no consequence during life, as, for instance, many of those which form in connexion with the pleural surfaces. If, however, they are extensive and firm, or if they occupy certain regions of the body, they may prove of serious moment. The principal evils which are liable to result from adhesions may be thus indicated:—1. They often bind parts together, and interfere with the movements of important organs, such as the lungs, heart, stomach, or intestines; in this way preventing the due performance of their functions. 2. When an organ is displaced in any way, as, for example, the heart by pleuritic effusion, it may become fixed in its new position by the formation of adhesions, its functions being thus disturbed. 3. It is highly probable that agglutination may lead to hypertrophy of an organ, *e.g.* the heart, by embarrassing its movements, and hence affecting its action. 4. On the other hand, atrophy or degeneration of structure may ensue, in consequence of the adhesions interfering with the due supply of blood by pressing upon the vessels, so that the nutrition of the tissues becomes impaired. In the young, also, their development may be checked. 5. Adhesions may involve important structures, such as nerves or vessels, pressing upon or destroying them, thus giving rise to symptoms of a serious nature. 6. Tubes or canals for the passage of secretions or other materials are sometimes narrowed or obliterated by adhesions. 7. When formed within the abdominal cavity, especially when they take the form of bands, adhesions may prove highly dangerous by compressing, constricting, exerting traction upon, or strangulating some portion of the intestine, in either of these ways leading to intestinal obstruction.

It is frequently difficult or impossible to determine the existence of adhesions by clinical investigation during life; but the history of some past illness during which they were likely to be formed, the results of physical examination, especially in connexion with the heart and lungs, and the symptoms present, not uncommonly enable them to be discovered. FREDERICK T. ROBERTS.

ADIPOCERE (*adeps*, fat; and *cera*, wax).—SYNON.: Fr. *Adipocire*; Ger. *Fettwachs*.

DEFINITION.—A substance formed by a spontaneous change in the dead tissues of animals.

DESCRIPTION.—As seen generally in a dried state in museums, adipocere somewhat resembles spermaceti in consistence, but it is less crystalline in fracture, and is of a dull white or buff colour, the surface being sometimes marked by the outlines of blood-vessels or of other textures. Adipocere in the earlier stages of its formation, or when formed in a damp situation, is soft, and if rubbed between the fingers communicates a greasy feeling. The odour is peculiar and rather disagreeable.

CHEMICAL COMPOSITION. — Adipocere dissolves in ether, and leaves a delicate filamentous web; it burns with a blue flame, and yields a white ash. It is properly described as a soap, composed of margaric and oleic acids in combination with ammonium, the fixed alkalis, and alkaline earths; the relative proportion of the latter ingredients varies with the age of the specimen (the ammonia disappearing), and with the composition of the fluids in contact with which the adipocere has been formed. It is said that oleic acid predominates in adipocere formed from dead fish.

MICROSCOPICAL APPEARANCES.—When the flesh of animals in which this transformation has recently commenced is examined with the microscope, it is found to be composed of broken-down or disintegrated tissues, fatty granules or particles, together with a few acicular scales or crystals. The granules may be seen in what had been muscular tissue to assume somewhat the arrangement of the muscular fibrillæ, thus presenting an appearance resembling an early stage of fatty degeneration. In old and dry specimens of adipocere the crystalline scales form the great portion of the mass, and they may be observed preserving the outlines of the muscular fibres.

ORIGIN.—Adipocere has long been known. It is formed readily from the flesh of animals exposed to moisture, or placed in running water, in very dilute nitric acid, or in alcohol and water in the proportion of 1 to 6. It is often met with in inconvenient abundance in the specimen jars of the anatomist. The bodies of men and other animals buried in peat moss have frequently been found completely converted into adipocere. Lord Bacon mentions it in the *Sylva Sylvarum* (cent. vii. § 678), and so also does Sir Thomas Brown in the *Hydriotaphia;* but attention was especially called to its presence when a vast number of bodies were removed (in 1786-87) from the *Cimetière des Innocents* at Paris to the Catacombs. Fourcroy found many of these bodies converted into what he named *adipocire*, a name since retained.[1] Gibbes (as did others) suggested the possibility of applying adipocere formed from the waste flesh of animals to some useful purposes, but the tenacity of the disagreeable odour and the presence of other difficulties have prevented these suggestions from being carried out (*Philosoph. Trans.* 1794, p. 95). With respect to the immediate changes which give origin to adipocere, chemists have differed in opinion. One class believes, with Gay-Lussac and Berzelius, that the compound results from the fat originally present in the tissues, and that the other components are completely destroyed by putrefaction. Another class which includes the names of Thomas Thomson and Brande, maintains 'that the fatty matter is an actual product of the decay, and not merely an educt or residue.' These opinions may, the present writer thinks, be reconciled by the better knowledge we now possess of the elementary composition of tissues. We know that the combination of fat and albumin constituting one of the earliest steps in the process of nutrition is traceable in the further development and formation of nearly every texture. When that combination is destroyed by a cessation of the processes of life, the tissues are, as it were, resolved into their primary elements. We may thus have adipocere derived not only from free fat, but from the elements of fat existing in and obtained from the decomposition of other tissues. Adipocere may thus be described as both an educt and a product. This opinion is confirmed by the researches of Bauer and Voit, who showed that fatty matter was derived from the metamorphosis of albumin in starved animals, to which phosphorus had been administered.[2]

PATHOLOGICAL RELATIONS.—The medical jurist has studied this substance with the view of determining the time and progress of its formation, and of thus ascertaining the probable period at which death had occurred. But hitherto no decided or satisfactory information has been obtained, owing to the varied circumstances which influence the progress of the change, in connexion not only with the condition of the body itself, but also with the character of its surroundings. The formation of adipocere has a further and a special interest for the pathologist. It was the study of this process which led the present writer to discover the analogy which exists between it and fatty degeneration in the living body, and thus to establish the pathological doctrine that fatty degeneration is the result of a retrograde metamorphosis, not a form of perverted nutrition. (See *Medical and Chirurgical Transactions*, vol. xxxiii.) RICHARD QUAIN.

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[1] A curious illustration of this process is incidentally mentioned by Mr. L. Field. The Illinois limestone, he says, proves to be composed of coral, in each cell of which a particle of oil is found sealed up—'the result of the decomposition of the animalcula.'—*Journal of the Society of Arts*, 1883. p. 869.

[2] The writer would desire to refer here to the remarkable analogy which exists between the change of animal matter into adipocere, and that which occurs in vegetable matter by its conversion into peat and coal.

ADIPOSIS.—A term which properly signifies either general corpulency, or accumulation of adipose tissue in or upon an organ. *See* FATTY GROWTH; and OBESITY.

ADIRONDACK MOUNTAINS, in New York State.—A series of ranges rising from a plateau 2,000 feet above the sea, with picturesque lakes between them. Highest altitude, Marcy, 5,337 feet. Commodious hotels on the shores of the lakes. Much frequented as a summer climatic resort. Recommended in phthisis. *See* CLIMATE, Treatment of Disease by.

ADYNAMIA
ADYNAMIC } (ἀ, priv.; and δύναμις, power).—Terms indicating serious depression of the vital powers. The noun is employed as synonymous with the '*typhoid condition*.' The adjective is applied to diseases in which the phenomena of this condition are prominent. *See* TYPHOID CONDITION.

ÆGOPHONY (αἴξ, a goat; and φωνή, voice).—A peculiar alteration of the resonance of the voice, as heard on auscultation of the chest, compared to the bleating of a goat. *See* PHYSICAL EXAMINATION.

ÆTIOLOGY (αἰτία, cause; and λόγος, word).—That branch of pathological science which deals with the causation of disease. *See* DISEASE, Causes of.

AFFINITY.—This term is the designation of a property by which elementary and compound substances unite with one another and form new compounds. It is, therefore, a property with which chemists are principally concerned. But the ideas suggested to the chemist by the term affinity are also, though less explicitly, excited in the mind of the pathologist and of the therapeutist by certain classes of facts frequently falling under their observation. The pathologist, for instance, knows that saline or earthy matter is very prone to accumulate in the midst of degenerated tissue in the walls of an artery or of a cardiac valve, so as to give rise to a patch of 'calcification'; he knows that in a gouty patient urate of sodium is most apt to accumulate and form 'chalk stones' in the tissues around affected joints; he knows that, however it may be administered, arsenic in poisonous doses tends to produce inflammation of the alimentary canal, that strychnine acts with preference upon the nervous system, and that in ordinary cases of lead-poisoning this metal interferes especially with the nutrition of the extensor muscles of the forearm. Applications of the same notion in the department of therapeutics are equally familiar in respect to the action of many drugs. It may be regarded as an ascertained fact that iodide of potassium tends especially to influence the nutrition of the fibrous structures in the body, and that bromide of potassium has a no less certain action in modifying the nutrition of the nervous centres in many unhealthy states. Again, there is a whole class of substances which when taken into the system have, whatever their other actions may be, an undoubted effect in modifying the functional activity of the kidney. We have in nitrite of amyl and in nitroglycerine remedies possessing a remarkable influence over the unstriped muscular fibres of the arteries and bronchi, or else over the nerve-centres by which they are controlled. We have in woorara an agent which acts especially upon the motor side of the nervous system; and we have in digitalis an important remedy which, amidst its other effects, seems to have a decided power of improving the activity of the cardiac ganglia. The recent progress of therapeutics encourages us to hope that more and more of these specific effects of drugs will be accurately determined, so that the notion implied by the term *affinity* may, after a time, have a deeper meaning than at present for the practitioner of medicine.[1] *See* ANTAGONISM.

H. CHARLTON BASTIAN.

AFFUSION.—A method of treatment which consists in pouring a fluid, usually water, either cold or warm, upon the patient. *See* WATER, Therapeutics of; and BATHS.

AFRICA, SOUTH.—The portion of this continent lying between 22° and 35° south latitude, and 18° and 32° east longitude, and including Cape Colony, Natal, Bechuanaland, the Orange Free State, and the Transvaal, thus embracing the region at present available for health-resorts, and excluding the recently acquired British and German territories.

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[1] Dr. James Blake states that we must look elsewhere than to chemistry for the nature of the reactions between living matter and the reagents with which we may bring them in contact: and that this problem will be solved when the spectroscopic characters of the elements are better known. He holds that not only are toxic actions not chemical actions, but also that the whole direct action (of metallic salts) on the most important functions of living matter is a physical molecular action determined by the number and character of the harmonic vibrations of which the reagents are the seat. (*Comptes Rendus de la Soc. de Biologie*, 1890.)

The physical features of this tract of country consist of: (1) a low-lying coast of varying extent, characterised generally by a warm and moist climate, and being in many parts swampy and malarious; and (2) an inland region, rising in terraces to 6,000 feet and upwards. This more or less elevated district, ascending in plateaux as the interior is approached, and varying in altitude from 1,200 to 6,000 feet, affords excellent sites for health-resorts. The climate of tracts at between 1,900 and 3,000 feet is warm and dry; but the most suitable one for invalids is to be found at the altitude of 4,000 to 5,000 feet, on the vast rolling grassy plain, or *veldt*, of which the Orange Free State, the Transvaal, and the Karoo District of the Cape are the best examples. Here the climate is characterised by great sunniness, dryness, and liability to extremes of temperature, though the night record seldom falls below the freezing-point.

Cape Colony.— Cape Colony consists of eastern and western provinces, presenting varieties of climate according to elevation, of which the inland portions are far preferable. As the rainy season occurs in the winter in the west, and in summer in the eastern province, the wet season may be avoided by travelling from one to the other. The general meteorological features of the colony are great dryness; moderate heat; small rainfall, precipitated in heavy showers on a small number of days; and a variable amount of wind.

None of the *coast towns* are suitable for invalids, but in the neighbourhood of Cape Town, *Rondebosch*, *Claremont*, and *Wynberg*, situated on the wooded slopes of Table Mountain, can be recommended for temporary sojourn.

Graham's Town (1,000 feet), in the *eastern province*, 100 miles from the sea, has an equable and genial climate, with a summer heat which is tempered by rain, the larger proportion of which falls at that season. Mean annual temperature, 60° Fah., the summer mean being 63° and the winter 53°; the mean range, 15°. Rainfall 26 inches, distributed over 84 days.

Ceres (1,700 feet), in the *western province*, 85 miles by rail from Cape Town, has a somewhat moister climate than Graham's Town, and possesses an excellent sanatorium with many social advantages.

The higher plateau of the colony contains the following suitable stations :—

Aliwal North (4,348 feet), 280 miles by rail from the port of East London, with a fine, clear, dry climate, which in the writer's experience has proved useful to many cases of phthisis. The rainfall is 18 inches, distributed over 61 days, but occurring chiefly in summer, and sharp frost is occasionally recorded in the winter nights.

Tarkastad (4,280 feet), *Dordrecht* (5,200 feet), and *Burghersdorp* (4,650) have similar climates, the last place being connected by rail with Aliwal North, and within easy access of several stations higher and lower in elevation. The rainfall is 11·39 inches, and the number of rainy days 41.

Cradock (2,850 feet) and *Beaufort West* (2,792 feet) are both accessible by rail, and, though at lower altitudes, enjoy very fine climates. At the former the humidity is 62 p.c., the average summer maximum 91° Fah., the rainfall 9·18 inches in 45 rainy days, showing great dryness of climate.

Orange Free State. — *Bloemfontein* (4,540 feet) is to be recommended, and undoubtedly the Orange Free State offers many advantages in its vast *veldt* and dry climate, but it still lacks railway communication, though this is projected. A drawback, too, is the occurrence of dust-storms to which it is liable. At Bloemfontein the average maximum for the six hottest months of the year is 82° Fah., the average minimum 55°, the humidity 55 p.c., the rainfall 16·97 inches, and the number of rainy days 70. Patients are able to sleep in the open air, except during a small part of the winter, when night frosts occur, and in the rainy season; and by day the outdoor life can be thoroughly carried out, either on the trek or while residing at a farm.

The Transvaal.—The Transvaal is at much the same elevation as the Orange Free State, but is said to have a moister climate. *Pretoria* (4,007 feet), the capital, and *Heidelberg* have been recommended as suitable stations for invalids.

Natal.—The colony of Natal, situated to the N.E. of the Cape Colony, has a tropical climate, and is distinguished for its luxuriant vegetation and moister climate. As in the Cape Colony, the coast district, including Durban, is not suitable for invalids, but the slopes of the Drakensberg Mountains, which separate Natal from the Orange Free State, are cooler and more salubrious.

Here *Howick* (3,400 feet), *Estcourt* (3,562 feet), and *Ladysmith*—all connected with Durban by rail—offer the invalid many advantages, in a dry climate, warmer than that of the Orange Free State, and fairly protected from cold winds; and they have proved of great benefit in bronchitis and asthma.

The mean annual temperature of *Pietermaritzburg*, the capital of Natal (2,090 feet), 71 miles from the sea, is 64·7° Fah., the winter being 60° and the summer 69°, whilst the rainfall is 30 inches, occurring chiefly in October and March.

C. THEODORE WILLIAMS.

AGEUSTIA (ἀ, priv.; and γεῦσις, taste).—Loss of taste. *See* Taste, Disorders of.

AGONY (ἀγὼν, strife or struggle).—Agony implies bodily pain or mental suffering so intense that it cannot be endured, but excites a struggle against it. It is also applied to the final struggle that often precedes death. *See* Death, Modes of.

AGORAPHOBIA (ἀγορὰ, a market-place; and φόβος, fear).—Synon.: Fr. *La peur des espaces.*—By these names a peculiar nervous complaint has been recognised, characterised by a feeling of alarm and terror, associated with a group of nervous symptoms, which some individuals experience when they are in a certain space. The condition may be developed rapidly or gradually, and the chief phenomena observed are as follows :—A sudden sensation is experienced, as if the heart were being grasped, while this organ palpitates violently; the face becomes flushed; the legs feel weak, tremble, and seem as if they would give way under the body. There may be sensations of itching, coldness, or numbness; or profuse sweating may occur. There is no true vertigo; the special senses are unaffected; and consciousness is not at all impaired. A curious impression is sometimes experienced, as if space were elongating itself out indefinitely. Persons who are thus affected are quite sensible of the foolishness of their fear, but cannot be reasoned out of it. During the attacks they feel a strong inclination to cry out, but hesitate to do so. They think that their dread is known to others, and many of them endeavour to conceal their feelings, lest they should be considered insane.

The circumstances under which the symptoms just described may be experienced are various. They may be felt, for instance, in the street, especially if the shops are shut; in public buildings, such as churches, concert-rooms, or theatres; in omnibuses, cabs, or other conveyances; on a bridge; or in looking at an extended façade or flying perspective. Most persons who suffer thus in the street feel better when with some one, or when near some object, such as a carriage, or even when carrying an umbrella or a stick. Occasionally, however, they shun other people, especially acquaintances.

But little is known as to the origin and nature of agoraphobia. The complaint is not regarded as idiopathic, but as sequential to some other condition. It occurs in males and females, and the individuals affected may be strong and in good bodily health, while they are often intelligent and well-educated. A history of hereditary nervous disorder can be traced in some cases, indicated by the occurrence of insanity or epilepsy in members of the family; and the patients themselves may present indications of a nervous temperament. Their emotions are often easily excited; and they may be subject to nervous symptoms, such as headache, a feeling of heat in the top of the head, sparks before the eyes, occasional faintness, or motor disorders.

Treatment.—Special attention should be directed to maintain the general health in its widest sense, and particularly to give strength to the nervous system. Active mental occupation, and pleasing social and moral surroundings, will generally succeed in relieving and ultimately curing the malady.

Frederick T. Roberts.

AGRAPHIA (ἀ, neg.; and γράφω, I write.)—This term is applied to defects of intellectual expression by writing rather than by speech. These defects may occur alone, or in association with defects of speech, according to the extent and situation of the lesion or nutritional defect in different cases. *See* Aphasia.

AGRIA (ἄγρως, wild).—This term signifies angry and severe. Willan describes a *Lichen agrius*, which is likewise termed *agria.* It is a circumscribed inflammatory eczema, situated on the back of the hands. The qualities implied by agria are excessive pruritus, burning pain, thickening, fission, and copious exudation. *See* Lichen.

AGUE.—A popular synonym for intermittent fever. *See* Intermittent Fever.

AGUE-CAKE. –A form of enlargement of the spleen, resulting from the action of malaria on the system. *See* Spleen, Diseases of; and Malaria.

AIKIN, in south-west division of South Carolina.—A mild, bracing, dry climate, said to resemble that of Mentone in warmth and dryness, but with larger monthly temperature range. Soil, sandy. Recommended for pulmonary affections. *See* Climate, Treatment of Disease by.

AINHUM (Nat., to saw).—This disease was first described by Dr. da Silva Lima of Bahia in 1867. It is peculiar to the African race, being found not only amongst the inhabitants of the West Coast of Africa, but also amongst the Hindoos of African descent, as well as amongst the slave population of South America. At its commencement, a groove or furrow is seen at the base of the little toe (the part almost invariably attacked), situated on its inner and inferior aspect, and corresponding to the digito-plantar fold. The furrow soon extends to the entire circumference of the toe; and, as it becomes gradually deeper, the latter is left hanging by a slender pedicle, which can only be brought into view by separating the walls of the furrow. The distal portion swells into an ovoid mass, about twice its natural size; finally some accident snaps the pedicle, and the toe drops off. in from four to ten years from the commencement of the disease.

The furrow is caused by a constricting band of hardened and contracted skin—a local scleroderma, which leads to faulty nutrition and degenerative changes in the parts beyond.

Ainhum is not a painful affection in itself, but the extreme mobility of the little toe causes trouble and inconvenience, for which patients often seek relief in amputation.

Occasionally the sides and bottom of the furrow ulcerate. Not infrequently both little toes are attacked by the disease. Males are more subject to it than females. The microscope reveals only atrophic and degenerative changes. The cause of ainhum is entirely obscure. It has been cured by the early division of the constricting band.

A. Sangster.

AIR, Ætiology of. — *See* Disease, Causes of.

AIR, Therapeutics of. — Air is employed in the treatment of disease in many ways and for many purposes. It is used, firstly, as *the atmosphere*, a gaseous mixture of definite composition and with a variable pressure. Secondly, advantage is taken of air as a *vehicle* for other substances in the gaseous or finely divided state. And, thirdly, it is selected as a *medium* by which *the temperature* of the body may be readily and effectively influenced. In the first of these relations only—as pure air—will its therapeutics require to be considered in this article. The application to the body generally of air that has been warmed, or warmed and loaded with moisture, will be found described in the article on Baths; whilst its administration to the respiratory organs, either in this form or as a vehicle for such substances as creasote, carbolic acid, alkaloids, and sulphurous acid, will be discussed under Inhalations.

Principles.—The dual relation in which the air stands to the economy—as a definite compound of certain gases, and as an atmosphere with a certain pressure—is very frequently disturbed; and this disturbance accounts for some of the most familiar phenomena of disease. Alteration in the quality or quantity of the respired air, whether from the state of the atmosphere itself, or from derangement of the complex apparatus of respiration and circulation, is the cause of some of the most serious and distressing symptoms attending diseases of the chest. It might be predicted by the physiologist that under these circumstances relief would be afforded, at least to symptoms, by suitable alteration of the composition or volume of the air. The method of treatment thus rationally indicated proves to be readily practicable: the supply of air is unlimited; its composition may be altered at pleasure; its pressure may be increased or diminished; and such alteration will alter its chemical properties. We find accordingly that, ever since the discovery of the composition of the atmosphere, frequent trials have been made of its value therapeutically. Oxygen was early recognised as its active constituent, and came to be administered, as it still is, in the form of inhalation. From time immemorial, indeed, advantage has been taken of the purity and certain other unknown qualities of the air for the prevention and treatment of disease; and the character of the atmosphere is naturally reckoned one of the most important elements of climate (*see* Climate). More lately, use has been made of the powerful properties that air possesses when *physically* changed. Within recent years remarkable advances have been made, on the one hand, in the physiology of respiration and the relation of the circulation to the atmospheric pressure, and, on the other hand, in the pathology of diseases of the chest. Clearer views have been reached on the signification of various symptoms, and especially of dyspnœa in its different forms. At the same time observations upon the effects of compressed and rarefied air have been becoming more exact. Pursuing the physiological track, modern therapeutists have availed themselves of this knowledge, and revived the use of air physically altered in the treatment of diseases of the lungs, heart, and other parts of the body. This application they are now able to make with accuracy, and the success of the reformed system of aërotherapeutics appears clear.

The physiological effects of compressed or of rarefied air will manifestly be different according as it is admitted to the body as a whole, or only to a part of it. Familiar examples of the former condition are afforded by descent in the diving-bell, or ascent in the balloon; and of the latter by the action of the cupping-glass, and the effects of interrupted or frequently repeated respirations upon the pulse and system generally. Under the first circumstances the alteration of pressure is absolute; under the second it is relative, and capable of producing most important disturbances in the distribution of the vital fluids. The two methods of application must accordingly be separately discussed.

General Aërotherapeutics.—The effects of *compressed air* on the body as a whole have been studied in the *air-bath*. This is a mechanical arrangement in the form of an iron chamber, which can be filled with air at any pressure, whether above or below the normal, by means of steam-power.

The principal *physiological effects* of air condensed by three-sevenths of an atmosphere were ascertained by von Vivenot to be:—Pallor of the skin and mucous membranes; a sensation of pressure in the ears; diminished frequency of respiration, the act becoming easier; enlargement of the lungs, and increase of the vital capacity; depression of the cardiac force, and diminution of the size and strength of the pulse; rise of temperature; increased vigour of muscular action, secretion, and nutrition generally; compression of the gaseous contents of the intestines; and, perhaps, increased absorption of oxygen and excretion of carbonic acid. When the pressure is excessive, dangerous or even fatal symptoms may supervene. Frequent exposure to condensed air will induce considerable increase of the vital capacity; and most of the other effects, both physical and chemical, will tend to persist. In a word, it may probably be said that the air-bath acts on the system, first, by increasing the general mechanical pressure; and, secondly, by admitting an increased amount of oxygen. In employing the air-bath, the patient is kept in it for a period of two hours, at first daily, but after some weeks less frequently. The pressure, which is employed in different cases at one-fifth to one-half of an atmosphere above the normal, must be slowly raised on admission, and reduced on removal of the patient.

Uses.—The number of diseases in which the air-bath may be given with success is limited: (1) In certain forms of dyspnœa. It gives great relief in spasmodic asthma, and may also afford temporary relief in emphysema; but its prolonged use appears to be positively injurious, as it increases the pulmonary distension. (2) In hyperæmia and catarrh of the air-passages, including pertussis. (3) In imperfect expansion or threatened retraction of the chest, as in the subjects of phthisis and chronic pleurisy. Compressed air has also been extolled in some forms of cardiac disease, and in general malnutrition.

The effects of *rarefied air* admitted to the body as a whole do not demand description in this place, either in their physiological or in their therapeutical aspect. Artificially rarefied air is never employed in the form of the bath; and the natural supply in elevated regions, which has found favour as a means of treatment in phthisis, is a subject that belongs to CLIMATE and PHTHISIS.

LOCAL AËROTHERAPEUTICS.—When it is desired to bring compressed or rarefied air into contact with the *respiratory* surface only, other apparatus must be employed. Different forms have been in use for some years, respecting which it will be sufficient to state that the air contained in a portable gas-holder is compressed or rarefied by simple mechanical means, and thereafter brought into relation with the air-passages by an arrangement of tubes and valves. There are four possible methods of application: (1) inspiration of condensed air; (2) expiration into condensed air; (3) inspiration of rarefied air; and (4) expiration into rarefied air.

Another apparatus, called the *pneumatic cabinet*, has been introduced more recently. It consists of an air-bath, built of steel and glass, to accommodate both the patient and the administrator. The disturbance of pressure within the chest is effected by rarefying the air in the cabinet by means of a bellows, and then allowing the patient to inspire from the external atmosphere through a tube from without. This procedure is in effect mainly inspiration of a relatively condensed air.

The *physiological effects* of the several methods of application may now be briefly stated.

Inspiration of condensed air.—Inspiration of air that has been condensed by one-sixtieth to one-fortieth of an atmosphere produces a sensation of extreme distension of the chest, accompanied by an actual expansion of the thorax and lungs, and an increased admission of air, so that inspiratory dyspnœa, if present, is relieved. At the same time the other thoracic contents are compressed, the systemic vessels fill, the arterial pressure rises, and the jugulars become distended. The lungs and heart will be comparatively anæmic. If the application of condensed air be frequently repeated, the vital capacity, the size of the chest, and the respiratory force may all be increased, and partial relief may be permanently afforded to dyspnœa.

Expiration into condensed air is most difficult of accomplishment, and the effect on the circulation does not differ essentially from that just described.

Inspiration of rarefied air.—Inspiration of air that has been rarefied by one two-hundred-and-fortieth to one one-hundred-and-twentieth—or even, after a time, by one-sixtieth—of an atmosphere, immediately causes the phenomena of inspiratory dyspnœa; the thoracic viscera are congested, and hæmoptysis may result, for the effect may be regarded as that of dry-cupping the pulmonary alveoli. The heart at the same time becomes full, and the jugulars collapse.

Expiration into air that has been *rarefied* by one-sixtieth of an atmosphere is attended with a sense of extreme compression of the thorax; at the same time there is actually a partial retraction of the lungs, an increase in the volume of expired air, and a corresponding diminution in the amount of residual air in the chest. Expiratory dyspnœa, if present, is relieved. While the lungs thus diminish in size, the other thoracic viscera are dilated —the heart and the pulmonary and other vessels within the chest being filled at the expense of those external to it, both arteries and veins. If the expiration into rarefied air be frequently repeated, the circumference of the chest will be diminished, while the vital capacity will be actually increased, along with increase of the inspiratory and expiratory force.

Uses.—The method of *inspiring condensed air* is obviously indicated in diseases where inspiratory dyspnœa is an urgent symptom. Spasmodic asthma, stenosis of the air-passages from anatomical causes, acute and chronic bronchitis, and atelectasis, have all been successfully treated by this method. In croup, where urgently indicated, it is most difficult or even impossible to employ it. In threatened phthisis it is used prophylactically, and in chronic phthisis it may usefully develop the healthy portions of lung; but it is contra-indicated in pyrexial cases, and may prove dangerous by inducing hæmoptysis. In chronic pleurisy it may prevent or remove the effects of collapse and retraction of the chest-wall. The inhalation of condensed air should also be of use in certain forms of cardiac dilatation, especially that due to mitral incompetence. Improving, as it does, the general nutrition, it may be combined with other remedies for anæmia. In the administration of condensed air, a 'sitting' should last from ten to thirty minutes, once a day—seldom twice.

Expiration into condensed air is not used therapeutically.

Inspiration of rarefied air may be regarded as a means of exercising the inspiratory muscles. Like the atmosphere of great altitudes, it may therefore be employed in persons with badly developed chests; and even in phthisis it may, by increasing the amount of blood in the lungs, prevent caseation and promote absorption of the products. In disease of the right side of the heart, it would assist the flow of blood from the veins into the lungs, but it is not likely to be employed for this purpose.

Expiration into rarefied air promises to be the most successful and most extensively employed of all the methods. In it, according to Waldenburg, we have the physical antidote for emphysema, and in his hands the majority of such patients are said to have been either cured or radically benefited. It has also afforded great relief in some cases of bronchitis, where it increases expectoration.

Other local applications of the physical properties of the air, as seen in aspiration, cupping, Junod's boot, and inflation, are described elsewhere in this work.

J. Mitchell Bruce.

AIR IN CELLULAR TISSUE.—*See* Emphysema, Subcutaneous.

AIR IN VEINS.—*See* Veins, Air in.

AIR-PASSAGES, Diseases of.—*See* Respiratory Organs, Diseases of; also Larynx, Trachea, and Bronchi, Diseases of.

AIX-LA-CHAPELLE, Waters of.—Thermal sulphur waters. *See* Mineral Waters.

AIX-LES-BAINS, Waters of.—Thermal sulphur waters. *See* Mineral Waters.

AKINESIA (ἀ, priv.; and κίνησις, motion). A synonym for paralysis of motion, whether partial or general. *See* Paralysis, Motor.

ALASSIO.—In Italy on the Mediterranean coast, between San Remo and Genoa. A mild, bracing, winter resort, sheltered by hills except on the south and east. Comparatively free from wind and dust. *See* Climate, Treatment of Disease by.

ALBINISM (*albus*, white).—Definition.—A state of whiteness or absence of colour of the integument and certain other tissues, consequent on defect of pigment-formation. The want of colour may be *complete* or *incomplete*; *partial* or *universal*; *congenital* or *accidental*. Partial albinism may be limited to a spot of small dimensions; or there may be many such spots of variable extent, dispersed over the surface of the body, and giving rise to the appearance which is denominated *pied* or *piebald*; whereas in universal albinism the defect of pigment is not restricted to the integument, but is especially remarkable in the iris and choroid membrane of the eyeball.

General Characters.—Persons and animals affected with albinism are called *albinoes*. It would seem more correct to limit the term albino to those in whom the absence or defect of pigment is universal, and demonstrable not only in the integument but likewise in the eyeball. In the true albino, therefore, the skin is white and pink and more or less transparent, and this both in the fairer and in the darker races of mankind; but in certain of the latter, where the pigmentary function is simply defective and not totally wanting, the colour of the skin may be grey or tawny, and more or less variegated and freckled. The hair, sometimes of a pure silvery or opaque white, may be diversely tinged with yellow or red; occasionally it is flaxen or possesses a greyish hue; and in some instances the whole body is covered with a white down. The iris is grey or pink, in accordance with the density of its fibrous structure, and the consequent facility of penetration of the colour of its vascular layer; or, as generally happens in the negro, it is blue. The pupil is contracted and brightly red, from the absence of the screen of protection usually afforded to the choroid membrane by its pigmentary layer; and for the same reason the rays of light penetrating the sclerotic and iris give a brilliancy of appearance to the fundus of the eyeball. The absence of pigment in the eyeball is productive of several peculiarities of character in the albino. In the first place the excess of luminous rays penetrating the coats of the eyeball interferes with the correctness of his vision; his retinæ are intolerant of light; he stoops his head, or droops his eyelids, to shelter his eyes; he sees with more comfort in the dimness of evening than in the light of the sun; he is near-sighted; and there is in many cases an oscillation of the eyeballs.

Ætiology.—Albinism is met with among

all races of mankind and in every country, but is most common amongst those who are subjected to insalubrious conditions of climate and hygiene. For these reasons it is not uncommon among the natives of the marshy coast of Africa; among negroes who are transferred to unhealthy districts in South America and the West Indies; among the inhabitants of the western coast of South America and Mexico; in certain of the islands of the Indian Ocean; and even in the northern regions of Europe. When albinism is congenital, it has been assumed to be due to an arrest of development; but when accidental, its existence must be referred to exhaustion of chromatogenous or pigment-producing function. Arrest of development has been inferred from the occasional persistence in albinoes of the membrana pupillaris, and of the fœtal down of the skin; from the more frequent occurrence of the condition in females than in males; and from the observation that albinoes are sometimes misshapen and feeble intellectually as well as physically. On the other hand it is well known that albinism is often associated with perfect physical strength and remarkable intellectual vigour. Among other causes to which it has been assigned are heredity, and debility, however induced.

Treatment.—The treatment of congenital albinism must consist in the application of those agencies which tend to strengthen and improve the general health. With regard to the special inconvenience resulting from the absence of pigment in the eyes, it has been observed that the difficulty felt in reading is greatly lessened by using screens or goggles made of some opaque material, such as aluminium, each perforated by a small opening, admitting only the rays of light from the object looked at. The treatment of accidental albinism will be considered elsewhere. *See* Pigmentary Skin-Diseases.

Erasmus Wilson.

ALBUMINOID DISEASE.—Synon.: Waxy, Lardaceous, and Amyloid Degeneration; Fr. *Dégénération amyloïde*; Ger. *Speckartige Degeneration* (Rokitansky); *Amyloide Entartung* (Virchow).

Definition.—A peculiar form of degeneration, affecting certain organs, and constituting in its effects a distinct and general disease.

Ætiology.—In the majority of cases albuminoid disease is preceded by long-continued suppuration, most frequently in the form of bone- or joint-disease; or else of destructive pulmonary phthisis, empyema, pyelitis, cystitis, and other affections, where there has been a constant drain of pus. In the absence of obvious suppuration, there is usually present an exhausting disease, as syphilis, ague, or some more obscure cachexia. It has been observed as a consequence of inherited syphilis. These antecedent conditions must be regarded as the cause of the malady, and it is only in the rarest instances that no such cause can be traced. It is not easy to recognise the connexion, but it may be pointed out that a drain of pus involves not only a loss of highly organised protoplasmic material, but also of potassium salts, which are contained in large proportion in the solid elements of pus, and which salts, as we shall see, are deficient in the affected tissues.

Anatomical Characters.— The organs affected are usually much enlarged, but sometimes they ultimately decrease in size. They are pale, being evidently anæmic, dense, dry, sometimes hard, and either generally or in certain spots translucent. In an advanced stage of the disease the parts appear as if soaked in wax, or other translucent material. If iodine, in alcoholic or aqueous solution, be applied to the affected parts, they are stained yellow, orange, or a deep mahogany brown, according to the degree of the morbid change. If the portions thus coloured be further treated with dilute sulphuric acid, a purplish black colour is produced. In fine sections stained with the aniline dye, methyl violet, the affected elements are coloured pink, while the rest of the tissue is blue. The contrast of colour thus produced is the best means of recognising the degeneration under the microscope. These characters depend upon the presence in the tissue-elements of a peculiar substance, allied to the albuminates, and containing, when approximately pure, about 15 per cent. of nitrogen. It is soluble in alkalis, not digested by pepsin, and not readily altered by putrefaction; it yields with iodine the characteristic colour just noted, which gave rise to Virchow's erroneous supposition of its being allied to starch, whence the name—*amyloid*. Opinions have differed as to whether this change should be regarded as an infiltration or a degeneration. The *albuminoid* material, however, being contained in the tissue-elements themselves, and not infiltrated between them, is probably not poured out by the vessels as such, but results from a transformation of the materials of the tissues. Moreover, minute analysis has never detected any trace of this substance in the blood itself. Chemical analysis of the affected organs shows a remarkable change in their mineral constituents, the potassium and phosphoric acid being very greatly diminished, as compared with healthy organs; while the sodium and chlorine remain normal, or are proportionately increased.

Albuminoid disease affects most frequently the liver, spleen, and kidneys. Next in order of frequency come the lymphatic glands, and the intestinal mucous membrane, especially its villi; more rarely the suprarenal bodies, the pancreas, the urinary mucous membrane, or the omentum are involved; and, quite exceptionally, other parts, such as the thyroid body, the generative organs, the heart, and the lungs. In most organs the small arteries and their appendages (glomeruli of the kidneys, Malpighian corpuscles of the spleen) are the seat of the morbid change; but in some, such as the kidney, secreting cells may also be affected. In the liver the hepatic cells have been thought to be involved, but the change is really in the swollen and degenerated capillaries, especially those of the middle zone of each lobule. The diseased elements are enlarged, translucent, and structureless.

Symptoms, Diagnosis, and Prognosis.—The *general* symptoms of albuminoid disease are anæmia, debility, a cachectic appearance, and sometimes capillary hæmorrhage. The *local* symptoms are chiefly important in the case of the liver, spleen, and kidneys. Uniform smooth enlargement of the liver and spleen, which can be referred to no other cause, may be due to the albuminoid change. Where the kidney is affected, albuminuria, dropsy, uræmia, and a train of symptoms arise, which, regarded as a whole, differ from those of other kidney diseases. Diarrhœa is a frequent symptom, probably referable to the degeneration affecting the intestinal mucous membrane. The *diagnosis* is greatly confirmed by (1) the simultaneous occurrence of disease in several organs; (2) a history of suppuration, or of some cachectic disease, especially syphilis. The *prognosis* is extremely unfavourable, and, when the disease is far advanced, it is hopeless.

Treatment.—Though in advanced cases treatment can avail but little, there is reason to think that were the occurrence of the disease anticipated, or its presence earlier recognised, prevention, or even cure, might be possible. The only real means of prevention is to check suppuration; and there is no doubt that since the adoption of antiseptic methods in surgery, and of more radical treatment of diseased bones and joints, albuminoid disease has become less common, at all events in London. In all such complaints as chronic joint-disease, psoas abscess, syphilitic disease of bone, or prolonged empyema, the probability of this frequently fatal *sequela* should be borne in mind, and guarded against by a suitable regimen. The diet should not only be generally nutritious, but should include more especially abundance of nitrogenous food (albuminates), as well as the potassium salts, which the affected tissues lack. These are, indeed, largely contained in the juices of fresh meat, and also in the green parts of vegetables. Among drugs, nutrient tonics, of which iron and cod-liver oil are the type, must hold the first place; but the administration of potassium salts, as proposed by Dr. Dickinson, is also indicated. Of these we should be induced, on *à priori* grounds, to select those of which the local action is least violent, and which cause little vascular depression, such as the bicarbonate or the citrate, or other organic salts.

J. F. Payne.

ALBUMINS.—Definition.—Albumins are substances closely resembling egg-albumin, the chief constituent of white of egg or albumen. To distinguish between the white of egg and its chief constituent, the former is spelt album*e*n, and the latter album*i*n. Albumins constitute a subdivision of the class of albuminous bodies, which includes all substances having a general resemblance to albumen. *See* Albumose; and Globulin.

Enumeration.—The subclass properly contains only two members, *egg-albumin* and *serum-albumin*; but the name *Bence-Jones's albumin* has been given to an albuminous body differing very considerably in its properties from the other two.

Characters.—Egg-albumin and serum-albumin are semi-transparent, yellowish, and structureless when dried. They are soluble in water; and this solution is coagulated by boiling. From the same solution they are precipitated by: (*a*) nitric acid; (*b*) salts of the heavy metals, for example, copper-sulphate; (*c*) acetic acid with potassium-ferrocyanide; (*d*) boiling with acetic acid and a neutral salt, for example, potassium-sulphate; (*e*) alcohol. Egg-albumin is distinguished from serum-albumin by the coagulum which it forms with nitric acid being insoluble in excess, while that of serum-albumin is soluble. Bence-Jones's albumin gives no precipitate with excess of nitric acid unless left to stand, or unless heated and left to cool, when it forms a solid coagulum. This coagulum redissolves on heating, and again forms on cooling. It is therefore an albumose (*see* Albumose). It may be separated from ordinary albumin by adding nitric acid, boiling, and filtering when hot. The ordinary albumin will remain on the filter while Bence-Jones's albumin will pass through, and will coagulate when the filtrate cools.

Modifications.—By the action of acids and alkalis albumin may be converted into *acid-albumin* and *alkali-albumin* respectively, neither of which is coagulated by boiling.

Acid-albumin may be formed in two ways: First, by dissolving solid albumin in concentrated nitric or other mineral acid with the aid of heat. Secondly, by heating an aqueous solution of albumin with one of these acids very much diluted (1 in 500). Although soluble in very concentrated or very dilute acids, acid-albumin is insoluble in moderately dilute acids. Therefore, when the solution in concentrated nitric acid is diluted with water, a precipitate is formed, which redissolves when much water is added. And, conversely, when acid-albumin is made by boiling a solution of albumin in water with very dilute nitric acid, the addition of more acid will throw down a precipitate, which redissolves if a very large excess of the concentrated acid be added, and especially if it be heated at the same time. On neutralising a solution of acid-albumin, a precipitate is thrown down, which dissolves very readily in excess of alkali.

Alkali-albumin, or *alkali-albuminate* as it is also called, is formed by dissolving albumin in caustic potash or soda; or by adding either of these to its aqueous solution and allowing this to stand, or heating it. This modification is not precipitated by heat, but is precipitated by neutralisation; the precipitate dissolving very readily in slight excess of acid. If alkaline phosphates are present in the solution, as they are in urine, alkali-albumin requires a slight excess of acid to throw it down, and is not precipitated by exact neutralisation, as acid-albumin would be under similar circumstances.

T. Lauder Brunton.

ALBUMINURIA. — Definition. — A condition characterised by the presence of albumin in the urine. Other albuminous bodies, not albumins, may be present in hæmoglobinuria, hæmaturia, pyuria, and spermatorrhœa.

Symptoms.—Albumin may occur in the urine without any symptoms whatever, but its continuous loss leads to anæmia and changes in the circulation, which usually originate a series of symptoms. These are: a pallid pasty complexion, dry skin, and tendency to œdema of the cellular tissue, noticeable on the eyelids and ankles; derangement of digestion, flatulence, occasional nausea, and irregularity of the bowels; nervous disorder, shown by muscular weakness, languor, lassitude, vague pains about the loins, and headache; calls to make water during the night; attacks of difficult breathing; palpitation, and frequently accentuation of the second sound of the heart over the aortic cartilage, and reduplication of the first sound over the septum ventriculorum.

Tests for Albumin.—The two tests usually employed to detect albumin in the urine are—first, boiling; and, secondly, the addition of nitric acid; both of which produce a cloud or precipitate. If the urine is turbid, the albuminous cloud may not be noticed; and therefore such urine should be filtered before the application of either test, unless the turbidity, being dependent on the presence of urates, is removed by heat cautiously applied.

Method of employing the test by boiling.—With the object of saving time the urine is often boiled at once, but the results thus obtained are liable to several fallacies, which will be subsequently described. In order to avoid such fallacies the following method should be pursued:—Ascertain the reaction of the urine; and, if it be alkaline or very strongly acid, add acetic acid in the one case, or liquor potassæ in the other, until its reaction is only slightly acid. Fill a test-tube to about one-third of its capacity with the urine, and hold it obliquely in the flame of a spirit-lamp, in such a manner as to heat the upper part of the fluid only, until it boils. If it be turbid from urates, it should be first warmed throughout until it becomes clear, and then the upper part only should be boiled. Finally, add a drop or two of acetic or nitric acid.

If albumin be present, it will form a cloud or a coagulum, more or less dense according to its amount. When there is much albumin, its quantity may be roughly estimated by allowing the urine to stand for a definite number of hours, so that the coagulum may subside, and then observing whether it forms a fourth, a third, or a half of the whole length of urine in the test-tube. A small quantity causes a cloud, but no distinct coagulum; and, if merely a trace be present, a faint haze only will be observed, which is best seen by looking through the test-tube at a dark object. The advantage of heating the upper part only of the urine is, that the lower portion, which remains clear, affords a standard by comparison with which a faint cloud in the heated part may be more readily detected.

Fallacies of the test by boiling.—The first fallacy is that albumin may be present, and yet no cloud or coagulum be produced on boiling. This may occur if the urine be alkaline or very strongly acid, because alkali-albumin or acid-albumin, which are soluble in water, may be formed. It is to prevent the formation of *alkali-albumin* that acetic or nitric acid should be added to alkaline urine before boiling. This addition of acid also causes the coagulum to separate more readily; and it should therefore be made when the urine is neutral. On the other hand, urine rarely or never contains sufficient acid to form *acid-albumin*, unless the patient has been taking mineral acids; and therefore the addition of liquor potassæ is not necessary except under these circumstances. The second fallacy of the test by boiling is, that a cloud resembling that of albumin may be produced, although the urine is free from this substance. This occurs when the acidity of the urine is too slight to hold the earthy phosphates in solution, the heat probably affecting the relation between the basic and acid phosphates which are normally in solution, whereby deposition of insoluble phosphate results, forming a cloud like that of albumin. The two clouds are readily distinguished by the addition of a drop or two of acetic acid, when if due to phosphates the cloud will disappear by solution, but if caused by albumin it will remain. If an excessive quantity of nitric acid be added, an albuminous cloud may also clear up; for albumin coagulated by heat is soluble in strong acid, though only to a slight extent.

Application of the nitric acid test.—Pour some urine into a test-tube, and then allow about one-fourth of its bulk of strong colourless nitric acid to trickle slowly down the side of the tube, so as to form a layer below the urine without mixing. Or the acid may be put in the test-tube first, and the urine poured on it. Both processes give the same result. If albumin be present, a haze or cloud will form close to the line where the liquids meet.

Fallacies of the nitric acid test.—1. Albumin may be present and yet escape detection, if the nitric acid is simply poured into the urine and mixed with it, as is sometimes done. For if there be too much or too little acid, acid-albumin is formed and dissolved; whereas, if the liquids form two distinct layers, as in the process already described, the acid gradually mixes with and shades off into the urine, so that, at a greater or less distance from the line where they join, it is certain to be of the proper strength to precipitate the albumin. 2. Albumin may be supposed to be present when it is not, from the formation of a cloud by the precipitation of acid urates. This cloud disappears on the application of heat; and another specimen of the urine tested by boiling gives no cloud. To avoid this fallacy, it is common to employ the test by boiling, in addition to that by nitric acid. 3. The third fallacy is not of common occurrence. It is due to the presence of fat or saponified fats in the urine. Urine containing these when simply boiled gives no cloud; but if nitric acid is added to it in the cold, or acetic acid when it is hot, the fatty acids are precipitated and form a cloud resembling albumin. This is distinguished by not being formed if along with dilute acetic acid some ether is added to the urine before boiling; the ether retaining the fatty acids in solution. If the precipitate produced by nitric acid be collected on a filter, and treated with ether, it will be dissolved, while an albuminous precipitate will not. Copaiba, which can be recognised by its odour, sometimes causes an opalescence in the urine, which is increased by nitric acid, but is removed by heat.

Additional tests for albumin.—When urine contains *mucus*, which would render the presence of an albuminous cloud obscure, a solution of ferrocyanide of potassium followed by acetic acid should be added: this will produce a cloud if albumin be present, whilst it rather clears up a turbidity due to mucus. A solution of pyro-phosphate of sodium also precipitates albumin. If a few drops of albuminous urine be poured into a test-tube containing one or two drachms of a saturated solution of picric acid, a precipitate is formed which does not dissolve on boiling, and thus differs from that due to albumoses. A strong solution of trichloracetic acid also gives a precipitate with albumin. These tests are sometimes useful in determining the presence of albumin in the urine in doubtful cases.

Quantitative Estimation of Albumin.—There are three methods in common use for this purpose. The first is easy but inexact. It consists in boiling the urine with dilute acetic acid in a test-tube, allowing the coagulum to subside for a definite number of hours, and then estimating the proportion it bears to the quantity of urine boiled—for example, a fourth, a third, &c. The second is the most exact, but is troublesome. It is like the first; but the urine is carefully measured before boiling, and the amount of coagulum is ascertained by collecting it on a weighed filter, washing, drying, and again weighing it. The third method is easy and tolerably exact. A tube of known length is filled with urine and placed in a polarising apparatus. From the amount of rotation which the polarised ray undergoes in passing through the urine, the amount of albumin it contains may be calculated. A fourth method has been recommended by Sir William Roberts. It consists in diluting the urine with water until it gives a haze on the addition of nitric acid, which does not become visible until between one-half and three-quarters of a minute after the acid has been added. This dilute urine contains 0·0034 per cent., or 0·0148 grain of albumin per fluid ounce; and from the degree of dilution required the amount contained in the urine may be calculated. A fifth method is that of Esbach. It is less accurate than Roberts's, but is convenient. It consists in precipitating the albumin from urine in a graduated tube by means of picric acid, and reading off the quantity of albumin precipitated after the tube has stood for twenty-four hours. The precipitant consists of 1 part of pure picric acid and 2 parts of citric acid in 100 parts of water. The tube is filled up to a mark with the urine, and about two-thirds of its bulk of the precipitant is then added; the exact amount necessary being indicated by another mark on the tube. The lower part of the tube is graduated with lines numbered $\frac{1}{2}$ up to 7, and these indicate the parts by weight of albumin in 1,000 parts of the urine by measure. Thus, if the upper level of the precipitate after twenty-four hours stood at 2, the proportion of albumin would be 2 in 1,000, or $\frac{7}{8}$ of a grain of dry albumin to the ounce of urine. The results given are rather too low, and the method gives the best results when the proportion of albumin is small, so that urines containing much ought to be diluted before the test is applied. It is unsuitable if quinine, antipyrin, or thallin is likely to be present in the urine

Pathology.—Albuminuria has been said to occur in consequence of various conditions: *e.g.* changes in the blood, changes in the circulation, changes in the kidney. Thus abstinence from salt, or a diet of eggs alone, is said to produce albuminuria by altering the constitution of the blood; and an alteration in this fluid is supposed to be partly the cause of the albuminuria observed in high fevers, scarlatina, diphtheria, and osteo-malacia. The albuminuria of heart-disease depends on changes in the circulation; and that of nephritis on alterations in the kidney. In order to distinguish more clearly between the different kinds of albuminuria we may divide them into—(1) *false* albuminuria, in which some other albuminous body than serum-albumin is present; (2) *true* albuminuria, in which serum-albumin, frequently accompanied by globulin, appears in the urine. In *true* albuminuria there is always some change either in the circulation through the kidney, or in the structure of the kidney itself. In *false* albuminuria the albuminous body passes out through the kidney, without there being any alteration either in its circulation or structure.

(1) *False albuminuria.*—The chief albuminous bodies occurring in false albuminuria are hæmoglobin, egg-albumin, globulin, and Bence-Jones's albumin (albumose). Hæmoglobin occurs in the urine whenever blood is present in it (*see* Hæmaturia), in which case it is contained in the corpuscles; or it may occur free (*see* Hæmoglobinuria), the blood-corpuscles, while still circulating in the vessels, having undergone solution. This may result from the inhalation of arseniuretted hydrogen, or from the introduction of bile-acids or of a large quantity of water into the veins. Hæmoglobin is also found in the urine in paroxysmal hæmoglobinuria, but the cause of the solution of blood-corpuscles in this disease is unknown. Egg-albumin is excreted by the kidneys, and appears in the urine, whenever it is injected directly into the circulation or under the skin, or when it is absorbed unchanged from the stomach or rectum. When taken into the stomach it is usually completely digested before it undergoes absorption; but when taken in such large quantities that the whole of it cannot be digested, part of it is absorbed unchanged and is excreted in the urine. Thus a diet consisting exclusively of eggs, especially when continued for several days, produces false albuminuria, and large enemata of eggs have a similar effect in animals, and probably also in man. Bence-Jones's albumin is of very rare occurrence. It is found in osteo-malacia. Like egg-albumin, it is excreted by the kidneys when it is injected into the circulation, or in large quantities into the intestine. It is almost if not quite identical with the hetero-albumose which Kühne finds to bo one of the products of imperfect digestion. It seems probable that those cases of albuminuria which appear to depend on imperfect digestion, are due to the passage into the systemic circulation of albuminous bodies, which have not undergone the proper transformation in the alimentary canal or liver. *See* Albumoses; and Albumosuria.

(2) *True albuminuria.*—In true albuminuria there must be some change, either in the circulation or structure of the kidney, for serum-albumin differs from the other albuminous bodies just mentioned in not being excreted by the healthy kidney. Some regard the alterations in the circulation which produce albuminuria as of two kinds:—(*a*) increased pressure of blood in the renal arteries; (*b*) increased pressure in the renal veins. Increased pressure in the arteries may depend either on general high arterial tension, or upon an increased local supply of blood to the kidney, owing to dilatation of the renal arteries, such as follows division of their vaso-motor nerves. Experiments seem to show, however, that increased tension in the renal arteries does not produce albuminuria, and that the only change in circulation which will cause it is increased pressure in the renal veins. Congestion of the renal veins may be produced by ligature of the renal arteries; and when the flow of blood through the kidney is temporarily arrested by ligature of the artery, the urine secreted after the removal of the ligature is albuminous. Venous congestion of the kidney also occurs whenever the onward flow of venous blood is obstructed, either by a ligature on the renal veins; by the pressure of a tumour or of the pregnant uterus upon them or the vena cava; by disease of the liver obstructing the vena cava; or by disease of the heart or lungs, such as tricuspid or mitral regurgitation, or chronic bronchitis and emphysema. The temporary albuminuria sometimes observed after cold bathing may also be due to venous congestion; and it is probable that albuminuria consequent upon lesions of the nervous system, is due rather to the changes which these produce in the circulation, than to any direct action of the nerves upon the tissues of the kidney itself. The albuminuria observed after varnishing the skin is probably due to the retention of some substance which acts as a poison. The structural changes in the kidney which cause albuminuria are acute and chronic inflammation, waxy degeneration, and cirrhosis. *See* Bright's Disease.

Treatment.—(1) In *false* albuminuria, where hæmoglobin appears in the urine, the treatment indicated is to counteract the solution of blood-corpuscles; and for this purpose quinine is very often useful. When other kinds of albumin appear in the urine, and are probably due to imperfect digestion, the treatment is to give some artificial digestive fluid. Arsenic is also useful. Regarding those cases of osteo-malacia in which Bence-Jones's albumin occurs, we unfortunately know very little.

(2) In *true* albuminuria, depending on venous congestion, the obstacle to free circulation should be removed, if possible ; and the congestion lessened, both by drawing the blood from the interior to the surface of the body, and by causing contraction of the renal vessels. The blood may be drawn from the interior to the surface by means of warm baths ; but in some cases these prove injurious rather than useful, and the employment of a wet pack, which has a similar effect on the distribution of blood without exciting the heart, is to be preferred. Cupping over the loins is serviceable : it probably acts by causing reflex contraction of the renal vessels rather than by actually draining blood away from them. The tone of the renal vessels may be increased by the employment of digitalis (*see* Diuretics) ; and this drug is useful even when no cardiac disease is present, although its good effects are still more marked when the congestion is dependent on disease of the heart. The constant drain of albumin from the body occasions anæmia, which not only produces many unpleasant symptoms, but tends to cause fatty degeneration of various organs, from which there is no reason to believe that the kidneys are exempt. The administration of iron, therefore, is the chief medicinal remedy in structural disease of the kidneys. It is useful by diminishing or removing the symptoms of anæmia, and the tendency to fatty degeneration consequent thereon ; and also by increasing the tone of the vessels, thus diminishing the loss of albumin. T. Lauder Brunton.

ALBUMOSES. — Definition. — Albumoses are proteid bodies derived by the action of digestive ferments (pepsin chiefly) upon albumins and globulins, and in their properties may be classed as intermediate between these proteids and the final product of digestion (peptone). They are formed during natural digestion in the stomach, and also in artificial digestion.

Enumeration.—Many varieties of albumoses have been described, collectively termed *proteoses*. The individual bodies differ somewhat, according as they are formed from albumins (albumoses) or globulins (globuloses) : for all practical purposes the term albumose is the best to use. The forms of albumose important in medicine are *hetero-albumose*, *proto-albumose*, and *deutero-albumose*, the last being closely allied to peptone.

Characters.—1. *Hetero-albumose* ('Bence-Jones's albumin') is insoluble in water, but soluble in dilute saline solutions, from which it is precipitated by heat if no free acid is present. In some cases it is precipitated at a temperature of 43° to 50° C., and redissolves on heating the liquid to the boiling point. Artificially prepared hetero-albumose is rendered partly insoluble by heating ; but the coagulum is soluble in dilute acids and alkalis, thus distinguishing it from the coagulum formed on heating a solution of serum-albumin or serum-globulin. Hetero-albumose is also precipitated from solution by saturation with magnesium sulphate or sodium chloride.

2. *Proto-albumose* and *deutero-albumose* are soluble in water, are not precipitated by heat, and are thus sharply distinguished from hetero-albumose.

These three albumoses have one reaction in common (besides those given by all proteids), viz., that with a trace of copper sulphate and an excess of liquor potassæ they give a pink-red colour (biuret reaction), the colour given by hetero-albumose being the least marked. They all behave in a peculiar way to nitric acid : if added *drop by drop* to a solution of hetero- or proto-albumose, nitric acid causes a precipitate, which is soluble in excess of the acid, but is also soluble on heating, re-appearing on cooling, and so on. With deutero-albumose, however, nitric acid causes no precipitate, unless common salt be added until the liquid is nearly saturated with it : the precipitate which is then produced by the acid behaves like the nitric acid precipitates of proto- and hetero-albumose. (For other distinctive reactions *see* Albumosuria.) Albumoses are distinguished from peptones by the nitric acid reaction ; as well as by their precipitation with acetic acid and potassium ferro-cyanide, and with neutral ammonium sulphate added to saturation. The characters of true peptones are that they are not precipitated by heat, by nitric acid under any condition, by acetic acid and potassium ferro-cyanide, or by saturation with neutral ammonium sulphate. This last test is the most distinctive. In the presence of ammonium sulphate to saturation they give the biuret reaction, and are thrown down by tannin. Sidney Martin.

ALBUMOSURIA. — Synon. : Propeptonuria.

Definition.—A condition in which albumoses are present in the urine. The condition where peptones are present (peptonuria) is not at present distinguishable from albumosuria. Peptonuria will therefore be considered under this heading.

Tests for Albumose or Peptone in Urine.—Urine containing albumoses or peptones shows ordinarily no special characteristics indicating their presence ; unless, in some cases, frothing when shaken. It may be dark- or light-coloured, of high or low specific gravity, and with or without deposit. In one case Kühne found a whitish deposit, consisting partly of albumose ; and in a similar case Bence-Jones found casts, ordinary albumin being absent. As a rule, however, albumose and peptone are present in solution in the urine. In searching for these, coagulable albumin must be absent, or if present removed by filtration after coagulation. The following methods are, therefore, to be used:—Heat the top of the column of urine in a test-tube in the usual way, but without the addition of acid. If a cloudiness appears, it is due to the precipitation of coagulable albumin, of phosphates, or of hetero-albumose (Bence-Jones's albumin). Continue the heating to the boiling-point; the cloudiness, if due to hetero-albumose, will clear up, that due to phosphates and albumin will remain. Add a drop of acetic acid; the phosphates will be dissolved up, the coagulated albumin will remain insoluble. A precipitate in urine, then, caused by a moderate heat and redissolving on boiling is hetero-albumose. This may be verified by determining the exact temperature at which the precipitation occurs: hetero-albumose is precipitated between 43° and 50° C. (109·4° and 122° Fah.), serum-albumin or globulin at 73°–75° C. (163·4° and 167° Fah.), and phosphates only when near the boiling-point; this last precipitate also redissolves on cooling. If the urine contains albumin or globulin, it must be boiled after the addition of a drop of acetic acid, and filtered. The filtered urine must then be tested for albumose in the way to be described. The presence of hetero-albumose is indicated by the last test just mentioned; in addition, it gives a characteristic nitric acid test. If to the *cold* urine nitric acid be added drop by drop, a precipitate forms which dissolves on heating, reappears on cooling, redissolves on heating, and so on: this is perfectly characteristic of the body, since the similar precipitate of albumin or globulin does not redissolve on heating. By neither of these reactions is deutero-albumose or peptone indicated, and urines containing these two bodies (one or both of them) are those usually classed as examples of 'peptonuria.' Their presence is shown by the following tests, which must be applied after hetero-albumose has been shown to be absent, and after coagulable albumin has been removed:—(*a*) A drop of dilute solution of copper sulphate added to the urine, followed by an excess of liquor potassæ, causes a pinkish-red colouration (biuret reaction); or a drop of diluted Fehling's solution may be added to the urine, and then an excess of liquor potassæ if necessary. If the deutero-albumose and peptone are present in small quantity, this reaction is not obtained. (*b*) The urine is added drop by drop to a saturated solution of picric acid; both deutero-albumose and peptone are precipitated, and are redissolved on heating, thus distinguishing them from mucin and from albumin.

The only accurate way of distinguishing deutero-albumose from peptone is to shake the clear urine in a test-tube with solid neutral ammonium sulphate. If the urine gives the two tests just described, and gives a precipitate with ammonium sulphate, it contains deutero-albumose. If it gives the tests and no precipitate with the salt, it contains peptone, and the case is one of true peptonuria. It is best, in applying these tests, to evaporate the urine to a small bulk.

Proto-albumose has not as yet been found in urine.

Quantitative Estimation.—This is of but little clinical value. It may be done by precipitating a measured quantity of urine with a large excess (ten times its bulk) of alcohol, collecting, drying, and weighing the precipitate.

PATHOLOGY.—The presence of albumoses and peptones in the urine is a pathological, not a physiological, phenomenon. These bodies are formed during normal digestion by pepsin and hydrochloric acid in the stomach, and peptones are also formed in pancreatic digestion. But although they are thus formed in the gastro-intestinal canal, they are not found in the absorbent vessels of the stomach and intestine in any appreciable quantity; neither in the veins nor in the chyle-vessels. In the general systemic veins and lymphatics they are not present; and their occurrence in arterial blood in small quantities is extremely doubtful. Lastly, they are not present in the living tissues, nor in the fluids which bathe them. If they are found in the urine, they are therefore either derived from the gastro-intestinal canal, or are formed from some pathological condition in the tissues, or perhaps in the blood. With regard to their first source, it is quite reasonable to suppose that the metamorphosis (probably into serum-albumin) which albumoses and peptones normally undergo when passing through the intestinal wall, may not take place in certain diseases where absorption is deficient, and that they may thus pass into the circulation, and be excreted by the kidneys in the urine. This, however, is a mere conjecture, to explain the occurrence of 'peptonuria' (albumosuria) in some cases of chronic dyspepsia with dilated stomach. The second source of the origin of albumoses and peptones in the body is a complicated one. If these bodies are formed in any organ, tissue, or fluid of the body, they are absorbed into the blood, and then find their way into the urine. It is known that if albumoses or peptones are injected into the blood of an animal they are excreted in the urine; that hetero- and proto-albumose pass out in the urine mainly as deutero-albumose; that deutero-albumose passes out chiefly as peptone; and that peptone is unchanged as it passes from the blood into the urine. The same facts probably hold good for the human organism.

Bence-Jones's albumin (hetero-albumose) was first found in the urine of a case of osteo-malacia; and Virchow found a similar body in the diseased bones. This, then, is a clear case of excretion of the albumose from the diseased part, the excretion of a proteid which is outside the normal proteid metabolism of the body. A similar albumose has also been found in a case, not of osteo-malacia, but of glycosuria (Gowers). In the case of all abscesses, whether acute or chronic, in empyema and purulent peritonitis, albumoses (or peptones) are found in the urine. Here the explanation is simple, since the pus contains albumoses, and these are simply excreted by the urine after absorption into the blood. In the case of abscesses and of osteo-malacia there are collections of cells which undergo disintegration; the proteids the cells contain (consisting almost solely of coagulable albumin and globulin) becoming partly transformed into albumoses. Whether this transformation takes place by the agency of bacteria present in the pus, or of a digestive ferment set free by the dying cell, is not at present known. This disintegration and gradual death of exuded cells, with the formation of albumoses, probably explains the occurrence of albumosuria and peptonuria in phthisis, in pneumonia, in epidemic cerebro-spinal meningitis, in cases of cancer and other malignant growths, in the puerperal state, in typhoid fever, and in organic liver-disease. In phosphorus-poisoning there is also great disintegration of many tissues and organs, and albumosuria (peptonuria) occurs; in scurvy and acute infectious diseases (especially measles) also it is sometimes present.

One form of peptonuria has been ascribed to an origin in the kidney-cells in cases of chronic nephritis, where some of the coagulable albumin which is being continually excreted is changed into albumose or peptone. Peptonuria may indeed alternate with albuminuria in these cases, and peptone may be present as well as albumin. Peptonuria with albuminuria is not uncommon in advanced chronic phthisis.

Albumose and peptone are also found in the urine in many other conditions, in which no explanation of their presence is evident; such as in many forms of inflammatory eruptions of the skin, in pemphigus, in urticaria, and in nervous diseases—cerebral hemiplegia, or psychoses.

Symptoms.—From the account given of the pathology of albumosuria and peptonuria, it will be seen that they are only to be regarded as symptomatic of other graver pathological conditions; and no symptoms can be very directly ascribed to the presence of albumoses and peptones in the body, as associated with the diseases which have been already enumerated. But there are certain physiological effects of these proteids which are important to recollect. When injected into the circulation of a dog, albumoses (and peptones to a less extent) markedly reduce the blood-pressure, and produce coma and death, while the blood remains uncoagulated for a long time after death. These effects are not necessarily associated with, or threatened by, the presence of albumosuria in man; possibly because the amount of albumose present in the blood at one time is never sufficient to produce them. And when such appearances as coma and uncoagulated blood after death are observed in the diseases already enumerated, they are ascribed either to the result of the grave lesion on the body generally, or the brain in particular, or to the retained chemical products of the waste of morbid tissues. It may be that albumoses and peptones form one group of these waste products, aiding the production of coma and of post-mortem fluidity of the blood.

Another physiological effect of albumoses is that of producing fever when injected into the circulatory system. The fever is to some extent proportional to the dose, and is produced even when the dose is insufficient to cause coma and fall of blood-pressure, and in animals (such as rabbits) whose circulation and cerebrum are not affected by the poison. Whether the fever of chronic phthisis is partly due to the absorption of these albumoses is not yet settled; this is simply a suggestion based on the facts mentioned.

According to our present knowledge, it may be said that the chief clinical significance of a large amount of peptone or albumose in the urine is an extensive cell- (and proteid) disintegration in the body; in many cases indicating pus-formation.

Sidney Martin.

ALCOHOL.— Synon.: Ethyl-Alcohol; Vinic Alcohol; Spirit of Wine. (C_2H_6O).

Alcohol is the product of a process of fermentation induced by the action of a microscopic fungus, *yeast*, upon certain kinds of sugar, especially grape sugar, but also upon that derived from the different varieties of starch and, in the same manner, upon milk sugar. In this process a peculiar metamorphosis takes place, by which alcohol and carbonic acid are produced in considerable amount, together with very minute quantities of succinic acid, glycerine, and other bodies.

Alcohol may also be produced synthetically from its elements—carbon, hydrogen, and oxygen.

As alcohol is very volatile, boiling at 172° Fah. (78° C.), it may be separated by distillation from the water with which it is at first combined. Other means must be resorted to, however, in order to separate the ultimate parts of this water, as a strong attraction exists between the two liquids.

Alcohol, diluted with about 95 per cent. of water, and subjected to the action of another microscopic fungus, is oxidised into aldehyde and acetic acid.

Physiological Effects.—Applied to the skin, alcohol produces a sensation of coolness, due to its rapid evaporation; but, if the application be continued sufficiently long, *irritation* is excited. The latter effect ensues immediately if alcohol is brought into contact with a mucous membrane. Its strong attraction for water seems to be the chief cause of this action.

Alcohol is a powerful *antiseptic*, probably from the fact that it is capable, even when diluted, of preventing the development of septic germs, such as vibrios and bacteria, as well as of paralysing the activity of those already formed.

There is scarcely any other therapeutical agent the *internal action* of which varies so much according to the dose given. In *small quantity*, and slightly diluted with water, alcohol promotes the functional activity of the stomach, the heart, and the brain; whilst a like quantity, largely diluted, exerts but a limited influence upon these organs: if, however, the dose of alcohol be often repeated, it is readily assimilated, and, becoming diffused throughout the system, undergoes combustion within the tissues of the body, imparts warmth to them, and yields vital force for the performance of their various functions. Simultaneously with this consumption of alcohol, the body of the consumer is often observed to gain in fat—a circumstance due to simple accumulation, the fat furnished by the food remaining unburned in the tissues, because the more combustible alcohol furnishes the warmth required, leaving no necessity for the adipose hydrocarbon to be used for that purpose. A quantity of 100 cubic centimètres of alcohol *per diem* (about three and a-half fluid ounces)—equivalent to about one litre of Rhine wine of medium strength—is sufficient to supply between one-third and one-quarter the whole amount of warmth requisite for the human body during the twenty-four hours. The warmth so supplied cannot be measured by a thermometer, however, any more than can that furnished by the internal combustion of other hydrocarbons, such as the oils and sugars. The subjective impression of increased warmth usually experienced after taking a dose of any alcoholic liquid is deceptive, and is only due to an irritation of the nerves of the stomach, and to the increased circulation of blood through the cutaneous vessels, particularly those of the head.

The increase of the action of the heart after taking alcohol is well known, and has often been expressed in figures. Recent experiments have also established this fact with regard to the respiration. The quantity of the inhaled and exhaled air in healthy men was increased by 7 to 9 per cent.; in one instance, after taking champagne, by 15 per cent.

Doses somewhat larger, but still sufficiently moderate not to cause intoxication, act, for the most part, in the same way; but, as an additional effect, they produce a distinct decrease of temperature in the blood, lasting half-an-hour or more. As far as the matter has hitherto been explained, this latter effect depends upon a directly depressing influence exerted by alcohol upon the working cells of the body, and upon a temporary paralysis of the vaso-motor nerves. The latter is followed, of course, by dilatation of the superficial vessels, particularly those of the head, in consequence of which a larger surface of blood is exposed, and the loss of heat by radiation into the air is increased, the temperature of the circulating fluid being thus lowered; whilst the combustion carried on by the cells being retarded, the generation of heat from this source is diminished. The quantity of carbonic acid eliminated is thus diminished, as is also the amount of urea excreted. After the organism has become inured to the action of alcohol, these effects upon the temperature of the blood are less distinctly, or in some cases not at all, marked.

The agreeable excitement at first caused by such doses of alcohol is succeeded by a reaction, characterised by lassitude and drowsiness, the latter condition usually lasting longer than the previous one of exhilaration.

The symptoms of intoxication produced by *larger doses* of alcohol are sufficiently well known. When the abnormal condition of excitement in the brain induced by this stimulant has been kept up, almost without intermission, for a length of time; or when it is suddenly withdrawn after the organ has been long subjected to it; the disturbance brought about is so great and persistent as to result in a complete overthrow of the reasoning faculties, and the condition known as *delirium tremens* ensues. At the same time that this pernicious influence is being exerted upon the cells of the brain, fatty accumulations may take place in other organs, particularly in the liver, heart, and connective tissues; the blood-vessels become diseased; and, in many instances, cirrhosis of the liver, kidneys, and meninges makes its appearance, as part of the general disorder of nutrition. The shrinking of connective tissue, characteristic of this last-mentioned complication, seems to depend upon the direct irritation caused by the presence of un-oxidised alcohol.

Under ordinary circumstances, and after the consumption of moderate quantities of alcohol, only slight traces of it are to be detected in the urine, and still less in the breath and perspiration. A long series of experiments, made by the writer's assistant, Dr. Bodlaender, on healthy men and animals, proved that altogether at the most 3 per cent. reappears. The fæces do not contain any alcohol at all. As regards the breath, pure alcohol imparts no taint to the exhalations of the body; the ethers and fusel oil, on the other hand, do so by reason of their being less readily combustible. It is very likely that alcohol is completely oxidised into carbonic acid and water during the process of assimilation; at least, no other secondary products resulting from its disintegration have as yet been detected.

Much importance is sometimes still attached to the experiments of Lallemand, Perrin, and Duroy in discussions on alcohol. They asserted just the contrary to the above. Anstie and Dupré in England had already proved their conclusions to be erroneous; the new experiments which Bodlaender carried out with great minuteness have removed every doubt on the subject.

THERAPEUTICAL APPLICATIONS.—There can be no doubt that a healthy organism, supplied with sufficient food, is capable of performing all its regular functions without requiring any specially combustible material for the generation of heat and the development of vital force. But the case assumes a different aspect when, in sickness, while the metamorphosis of tissue goes on with its usual activity, or with increased energy, as happens in many diseases, the stomach, refusing to accept or to digest ordinary food, fails to supply material to compensate for this waste. Here it is, then, that a material which can be most readily assimilated by the system, and which, by its superior combustibility, spares the sacrifice of animal tissue, is especially called for; and such a material we have in alcohol. *Small but oft-repeated doses* of alcohol, largely diluted with water, are generally well tolerated by the weakest stomach; and, thus given, the absorption and oxidation of the spirit goes on without difficulty or effort on the part of the patient's system.

According to the experiments of Dr. Frankland and others, the burning of 1·0 gramme of alcohol yields sufficient heat to raise the temperature of seven litres of water 1° C.; and the burning of 1·0 gramme of cod-liver oil suffices for nine litres. Now, in taking three tablespoonfuls of the oil daily, we yield about the same amount of warmth to the body as is given by four tablespoonfuls of absolute alcohol—the quantity contained in a bottle of light claret or hock. The oil, however, is digested and oxidised by the organs of the body with difficulty, while, for the assimilation of the alcohol, scarcely any exertion of the working cells is required. Thus, it can be demonstrated by calculation, as above mentioned, that heat-producing material, sufficient to supply nearly one-third the whole amount of warmth required by the body within twenty-four hours, is offered in a quantity of 100 grammes (about three-and-a-half fluid ounces) of alcohol. In this sense alcohol is a *food*; for we must regard as food not only the building material, but all substances which, by their combustion in its tissues, afford warmth to the animal organism, and, by so doing, contribute towards the production of vital force, and keep up the powers of endurance. Alcohol, therefore, diluted with at least 90 per cent. of water (in any convenient form of beverage), may be given with advantage, in small but oft-repeated doses, in most of the acute and chronic diseases where it is desired to sustain the strength of the patient, but where at the same time the digestive organs, from any cause, refuse to tolerate a more substantial form of nourishment, at least in quantities that would answer the necessities of the case. In such cases it is certainly not sufficient to call alcohol merely a *stimulant*. If alcohol served here only in the quality of a stimulant, its effect would soon pass away, leaving the patient more exhausted than ever; for the human organism is so constituted that it cannot be driven to perform its functions by the application of measures that simply stimulate, without supplying some new force to take the place of that put forth by the organs of the body under the impulse of excitement. To take a familiar illustration, alcohol thus given stimulates no more than does the readily combustible coal which we put in small quantities upon a languid fire, to prevent its going entirely out.

Recent experiments in the writer's laboratory (Geppert) have contributed the following facts to this part of the question. Twenty to 75 cubic centimètres of absolute alcohol, taken in water or in the form of port, brandy, or sparkling hock by healthy adults, who were accustomed to take no alcohol or only a moderate quantity, hardly altered the quantity of the consumed oxygen, and likewise left unaltered or very slightly decreased the excretion of the carbonic acid.

The principal point in this result is the unchanged standard of the consumption of oxygen. We know that the consumed alcohol is burnt in the organism, a minute quantity excepted. The alcohol was thus unable to increase oxidation, as its adversaries have still continued to assert; it had not contributed to a more rapid wasting of the organism; nor had it made the regular equal march of this wasting irregular and slow. On the contrary, it had substituted itself simply as fuel in order to sustain the normal temperature of life, the existence of which is necessary to keep the whole machine in motion. Alcohol acts here, generally speaking, as if we had given the person experimented upon oil or sugar. A part of the disposable oxygen which would serve for oxidising other substances, serves for the combustion of the alcohol, and keeps them intact for the organism.

Medium doses of alcohol act powerfully upon the brain and heart, and are therefore serviceable as real stimulants in cases where it is desirable to excite the cerebral and circulatory systems to greater activity. We must not forget, however, that while exciting this increased activity, such doses do not elevate the temperature of the body; on the contrary, where the effect can be measured, it is found that they depress it a little. By continuing to exhibit such doses, we can sometimes (in erysipelas, puerperal peritonitis, and similar diseases) lower febrile heat by alcohol where even quinine proves ineffectual. The consequences of this decline of fever-heat are an immediate restoration to consciousness, if delirium or stupor has been present; and, in any case, a general improvement in the feelings of the patient. Todd and his school, before the application of the thermometer, called this *the effect of stimulus*, while in reality the improvement is, to a great extent, due to the diminution of febrile disturbance. As fever patients can tolerate large quantities of alcohol without showing any sign of intoxication, it is allowable, and sometimes even necessary, to rise in the scale of doses beyond the limits ordinarily prescribed.

Of late years alcohol has been given during the night to hectic phthisical patients as a preventive against copious and exhausting attacks of sweating, and with a gratifying amount of success. Such patients certainly tolerate the remedy much better than has hitherto been generally supposed. It need hardly be said that, in cases of cardiac excitement, not resulting from fever, alcohol is at least to be used with caution.

MODE OF ADMINISTRATION.—One of the most important, but at the same time most difficult, points for decision is the exact nature and quality of the alcoholic drink to be prescribed or allowed to a patient who may require alcohol in some form. For *general use*, a pure claret, hock, or Moselle wine are the forms of alcohol most to be recommended. Cognac, champagne, old gin or whisky, and the heavier Southern wines, may also be used according to circumstances. But whatever drink may be selected, it must at least be free from fusel oil to such an extent that a healthy man, even after imbibing a considerable quantity, will not feel any other effects than those of a pure stimulus; that is to say, an agreeable exhilaration of spirits, neither accompanied by a sense of weight in the head, nor followed by that persistent overfilling of the cerebral vessels and dulness of ideas characteristic of the physiological effects of fusel oil.

The *fusel oils* (so called from their oily qualities) consist chiefly of propyl, butyl, and amyl alcohols, of which the last-named forms the largest proportion. In order to examine any specimen of alcohol with reference to its purity from these objectionable constituents, it is only necessary to rub a few drops between the palms of the hands for half a minute, by which rapid evaporation is caused, and then to smell the moist spot left on either palm. If the alcohol be pure, no odour whatever should remain, as ethyl alcohol evaporates very quickly; amyl alcohol, on the contrary, is much less volatile, and, if present in the liquid, will not have evaporated, so that its peculiar and unmistakable odour will remain to attest its presence as an impurity in the specimen examined.

This test is not applicable to the more complicated liqueurs and wines, as these all contain certain odoriferous organic principles of their own, which might disguise the smell of the fusel oil. The inoffensive quality of any given preparation, as a wine or spirit, can only be relied upon when one knows by experience that it *is* pure; and then it should always be obtained, if possible, from the same source, so as to ensure uniform purity.

To facilitate the process of estimating the quantity of any particular beverage necessary to be administered in order to produce a given effect, a table is subjoined showing the percentage of absolute alcohol contained in average specimens of the different kinds of wine, beer, &c., in common use.

Absolute Alcohol contained in—

Kumiss (a fermented liquor made from milk or whey). from 1 to 3 vol. per cent. Kefir is the same, but derived from the milk or whey of the cow, whilst kumiss comes from the milk or whey of the mare. Both contain much carbonic acid, which renders them easily digestible.
German beer[1]: from 3 to 5 vol. per cent.
Hock or claret: from 8 to 11 vol. per cent.
Champagne: from 10 to 13 vol. per cent.
Southern wines (port, sherry, madeira, &c.): from 14 to 17 vol. per cent.
Brandy and the stronger liqueurs: from 30 to 50 vol. per cent.

For *antipyretic purposes* one will need to give an adult daily not less than the equivalent of fifty cubic centimètres (about two fluid ounces) of absolute alcohol, in divided doses within an hour or two. Taking this as a starting-point, the dose suitable for each individual case can be estimated accordingly.

The great quantity of carbonic acid contained in certain 'sparkling' wines acts upon the temperature of a fever patient much in the same favourable manner as the alcohol itself; and when alcohol is to be taken as a food, it would seem that the impregnation with carbonic acid facilitates its absorption.

All that has been stated thus far with regard to the use of alcohol in sickness applies to children as well as to adults. Of course no reasonable person would accustom healthy children to the use of alcoholic beverages; but, in cases of disease, really good and pure wine or brandy can be advantageously employed, even for infants, either as a *stimulant*, an *antipyretic*, or *an article of food*, according to circumstances.

For *external use*, alcohol has been superseded by various more modern agents, of which carbolic and salicylic acids may be mentioned as the most important.

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[1] English beer will contain a little more, but the writer has made no personal examination as to exactly how much.

As regards the copious experimental literature on alcohol and its medicinal properties, the writer would refer to his *Vorlesungen über Pharmakologie*, Berlin, 1886, pp. 354–392, and to Professor v. Jaksch's and his own papers in the Transactions of the Congress for Internal Medicine, Wiesbaden, 1888, pp. 70–133. The two papers have also been reprinted in the same volume. C. Binz (Bonn).

ALCOHOLIC INSANITY. — *See* Alcoholism; and Insanity.

ALCOHOLISM. — Definition. — This term is applied to the diverse pathological processes and attendant symptoms caused by the excessive ingestion of alcoholic beverages. These are very different according as a large quantity is consumed at once or at short intervals, or smaller quantities are taken habitually; hence they are subdivided into those due to (*a*) *acute*, and (*b*) *chronic* alcoholism. To the *acute* forms of alcoholic poisoning belong acute catarrh of the alimentary mucous membrane, rapid coma, some cases of delirium tremens, and certain special forms of acute insanity; whilst to the *chronic* class are referred the prolonged congestions, the fatty and connective-tissue degenerations of the various organs and tissues, most cases of delirium tremens, nervous affections of slow onset and course, and the cachexiæ, which, in varying combinations, attend a continuously immoderate consumption of alcohol.

Ætiology.—That ordinary vinic or ethyl alcohol, in any and every shape, is a sufficient exciting cause of such *chronic* affections is beyond a doubt; moreover, we find that the more concentrated the form in which it is taken, the more surely and rapidly are they induced, and that, although some beverages give a greater liability to certain forms of disease than to others, yet the ultimate tissue-changes produced by all are practically similar, and of a markedly degenerative character. The purest alcoholic fluids will also induce the *acute* forms; but some of the phenomena observed in the worst cases of alcoholic poisoning have been referred, with some probability, to admixture with fusel oil, essential oil of wormwood, cocculus indicus, and other substances, more deleterious even than ordinary alcohol itself. *See* Alcohol; and Absinthism.

The *predisposing causes* of a sudden debauch, such as festive gatherings, example of companions, desire of relief from anxiety and melancholy, &c., scarcely require mention. Acute alcoholic coma is generally due to the rapid consumption of a large quantity, but occasionally it is caused by taking a smaller quantity in the presence of some special condition, such as starvation, prolonged exposure to cold, or debilitating disease.

Chronic habitual drinking is undoubtedly *hereditary* in many cases; not that the ancestors have necessarily been drunkards, but that the family is of unstable nervous organisation, and that the neurotic taint which shows itself in some members in such affections as epilepsy, hysteria, or insanity, is manifested in others by an intense craving for alcohol. Sometimes a pernicious education, by fostering habits of indulgence in early youth, has led to subsequent excess; and the prescribing of stimulants has occasionally been productive of similar harm. In the experience of the writer the exhibition of large doses in fevers and acute affections has never done this—indeed, in several instances, a great dislike to stimulants has been produced; but the custom of recommending small quantities to young people and women, as a remedy in hysteria, hypochondriasis, neuralgia, and allied disorders, or to relieve debility *post partum*, or the fatigues incident to their daily life, cannot be too strongly protested against. The effect of *occupation* is very marked. Brewers, publicans, potmen, and others who trade in alcohol are, as a class, very intemperate; and so frequently are commercial travellers, owing to peculiarities in their mode of transacting business. Sedentary employments, being more monotonous, are more baneful than outdoor occupations. Mechanics drink more freely than agricultural labourers; whilst night-labourers, cabmen, sailors when on shore, brewers' draymen, navvies, pitmen, and puddlers, consume an enormous amount of alcoholic fluids. *Social influences*, such as domestic unhappiness, rate of wages, unhealthy dwellings, bad drinking water, or an intermittent supply, are important factors in the causation of drunkenness. Under some circumstances, alcoholic excesses do less injury than usual, for example, in persons whose employment leads to copious sweating, or necessitates abundant exercise in a keen air; and some constitutions resist the baneful influence of alcohol to a remarkable extent.

Pathology.—A large amount of ardent spirits acts on the nerve-centres as a narcotic poison, and causes rapid death by coma. Smaller quantities produce intoxication, accompanied with or followed by an acute congestion and catarrh of the alimentary canal, especially of the stomach and duodenum. Habitual dram-drinking, by altering the chemical composition of the blood, and checking the normal changes of its corpuscles, exerts an injurious influence on the nutrition of the tissues. This is increased by the lessened consumption of food, and by the alterations in the calibre of the blood-vessels, set up at first by a special action on their vaso-motor nerves, and afterwards maintained by degeneration of their coats, and frequently of the heart itself. Moreover, alcohol probably interferes *directly* with the nutrition of the cell-elements of the various organs as it circulates through them; and it retards the elimination of effete materials—carbonic acid, uric acid, and urea.

Anatomical Characters.—(*a*) *Acute Alcoholism.*—Dr. Beaumont thus describes the appearances which he observed in the stomach of Alexis St. Martin, after an excess of alcoholic stimulants:—'Inner membrane morbid; considerable erythema, and some aphthous patches on the exposed surface; secretions vitiated.' On another occasion, 'Small drops of grumous blood exuded from the surface, the mucous covering was thicker than common, and the gastric juices were mixed with a large proportion of thick ropy mucus and muco-purulent matter slightly tinged with blood.' The post-mortem appearances in a case of rapid coma in a patient at King's College Hospital, after taking three pints of raw whisky, were:—Intense injection of the vessels of the pyloric end of the stomach and duodenum, with a peculiar blanching of the mucous membrane between them, giving rise to a vivid scarlet arborescent appearance on a white ground; two ounces of bloody serum in the pericardial sac, and about sixteen ounces in the right pleural cavity (the left being obliterated by old adhesions); double pneumonia of the lower lobes; extreme congestion of the kidneys; and engorgement of the large veins over the posterior part of the brain. Contrary to the usual statements, no alcoholic odour could be detected in the brain, and there was no increase of fluid in its ventricles. The heart, liver, and kidneys were fatty; but these changes were probably of older date. In similar cases Deverjie has noticed a bright red colouring of the pulmonary tissue; whilst Tardieu found pulmonary apoplexies in two cases, and meningeal hæmorrhages in five others. Death from *acute* delirium tremens leaves no marked characters: meningitis and coarse brain-lesions are extremely rare, whilst pneumonia is much more common. After repeated attacks, as well as in old drunkards, fatty degeneration of the viscera and various other chronic changes are found.

(*b*) *Chronic Alcoholism.*—The amount of fat in the blood is increased, or it becomes more visible. Chronic congestion and catarrh of the stomach, leading to atrophy of the gland-cells and an increase in the submucous connective-tissue, is very constant, but chronic ulcer is not frequent. The liver is at first enlarged from congestion, and may continue so from a subsequent infiltration with fat; but more frequently it shrinks, owing to cirrhosis. Lobar emphysema, chronic bronchitis, and hypostatic pneumonia are common. The heart is flabby, dilated, and presents fatty infiltration or even degeneration of its muscular tissue; but it may be hypertrophied, probably as a result of coexistent disease of the kidneys. The arteries and endocardium are studded with atheromatous deposits; the capillaries are congested, and the veins varicose. The kidneys exhibit the fatty, or, more commonly, the granular form of Bright's disease. The muscles are pale and flabby, and even in the bones formation of fat takes place at the expense of the bony texture. The nervous centres are atrophied and tough; the convolutions are shrunken; the nerve-cells and nerve-fibres are wasted; and an increased amount of serous fluid exists in the ventricles and subarachnoid space. The abnormal adhesion of the dura mater to the cranium, the large Pacchionian bodies, the opaque arachnoid, and the thickened pia mater, all testify to an exaggerated development of fibrous tissue. Occasionally hæmorrhage into, or softening of, the brain, consequent on the diseased state of its blood-vessels, is met with. The increase of connective tissue is especially marked in *spirit-drinkers*, and explains the emaciated appearance, prematurely aged look, sunken cheeks, and wrinkled countenance which they generally present. The *beer-* and *wine-drinkers*, on the contrary, are loaded with fat, not only in the viscera, but in the subcutaneous tissue and the omentum; and hence these subjects are corpulent, with oily skins and prominent abdomens, even when the face and extremities are wasted. Gouty deposits are also frequent. These differences, however, are not nearly so absolute as is maintained by many writers. Alcoholic paralysis is due to a multiple peripheral neuritis, leading to atrophy of the muscles supplied by the affected nerves. The presence of a variable amount of dropsy, a congested pharynx, chronically inflamed conjunctivæ, turgid capillaries, and occasionally papules of acne rosacea on the face, complete the morbid anatomy of the confirmed toper. The necropsy in *alcoholic insanity* discloses no specific characters.

Symptoms.—1. *Acute Intoxication.*—In this state the successive and varying mental phenomena, the disorders of common and special sense, and of the motor apparatus, are well known. These are followed by uneasy sensations and tenderness in the epigastrium, vomiting or retching, headache and vertigo, with dimness and occasionally yellowness of vision on stooping and rising again. The tongue is furred, the appetite is lost, and there is a constant feeling of thirst. The urine is copious and pale, but afterwards becomes scanty and loaded with lithates. The countenance is sallow, and the general lassitude and depression are very marked.

2. *Acute Alcoholic Coma.*—In slight cases of this condition, prolonged drowsiness is the chief symptom: but in the more severe forms the patient is quite insensible; the power of motion is in complete abeyance;

the breathing is stertorous; the face is usually pale, the features remaining symmetrical; the pupils are generally dilated, though they may be contracted or unequal; the pulse is slow and laboured; the skin feels cold and clammy; and the temperature is low—in one case it fell to 92° Fah. There may be albuminuria; and occasionally the urine and fæces are passed involuntarily.

3. *Chronic Alcoholism.* — The earliest symptoms of this form are muscular tremors, especially on waking; disturbed sleep; noises in the ears; dull headache; occasional vertigo; and disorders of vision. If there be also a foul breath, slightly-jaundiced conjunctivæ, watery eyes, and flabby features, with or without papules of acne rosacea around the nose and mouth, the combination is very characteristic. Irritative dyspeptic symptoms—the *vomitus matutinus* of Hufeland, and the signs of commencing or actual cirrhosis, of Bright's disease, or of fatty heart, frequently co-exist.

Alcoholic paralysis in its milder forms is marked by distressing pains in the extremities, especially in the legs, increased on deep pressure, redness and œdema of the feet and hands, restlessness, insomnia, and a gradually increasing loss of power, beginning in the lower limbs and afterwards extending to the forearm and arms. The gait is peculiar and uncertain, with the legs wide apart; and support by sticks or by an attendant is often required whilst walking. The hands are irregular and jerky in their movements; and the reflexes, especially the patellar-tendon reflex, are diminished or lost. The peronei and extensors of the leg, the extensor muscles of the thigh, and subsequently the extensors of the forearm and the triceps, are markedly atrophied, and exhibit the 'reactions of degeneration.' *See* Paralysis, Toxic.

In its most severe forms anæsthesia succeeds to hyperæsthesia, and complete paralysis of the above muscles, leading to a condition of talipes equino-varus of the feet, and wrist-drop of the hands, may come on; and gangrene has occasionally been noticed. Loss of memory and other psychical disturbances are common. Death is generally due to some cerebral complication, or to apnœa from paralysis of the respiratory muscles.

4. *Delirium Tremens.* — This form of alcoholism occasionally supervenes on a single debauch, but it much more frequently affects the chronic drinker. It generally comes on during a drinking-bout, but this may have terminated before the attack commences. In some cases it is undoubtedly determined by prolonged abstinence from food, mental distress, surgical operation or injury, or the onset of an acute disease, along with the ingestion of alcohol; in other cases no cause but the last can be traced. The first stage is indicated by inability to take food; marked anxiety and restlessness; tremor of the voluntary muscles; furred and tremulous tongue; cool skin, which is frequently bathed in perspiration; cold hands and feet; and a soft weak pulse. There is complete insomnia, or short periods of sleep are interrupted by terrifying dreams, and the patient's nights are tormented by visions of horrid insects, reptiles, and other objects pursuing him and eluding his attempts to escape from them or to seize them. Illusions of hearing are not uncommonly added; but the sense of smell is much more rarely involved. If there is no improvement, these troubles not only haunt his nights, but persist in the day-time; he becomes more incoherent, his mental alienation increases, and attempts at suicide are common. The pupils are now greatly contracted, but there is no intolerance of light. The pulse quickens, and is very feeble or even dicrotic; and the general symptoms become more marked. A prolonged sleep may occur in this stage, and the disease thus terminate. If it continue, the strength fails; the pulse becomes small, weak, and thready; the tremor increases; the tongue gets dry and brown in the centre; persistent coma-vigil and subsultus tendinum come on; the patient talks incessantly, and picks at the bed-clothes; finally death is ushered in by a delusive calm, or takes place in a paroxysm of violence. The writer has known cases in which an attack of delirium tremens always began by several severe epileptiform fits.

5. *Alcoholic Insanity.*—The forms of insanity caused by alcoholism are *acute mania* and *melancholia*, *chronic dementia*, and *oinomania*. In the first, homicidal impulses, and in the second, strong suicidal tendencies, *due to actual delusions and not to mere passive terrors*, are added to the other signs of delirium tremens. Oinomania is a peculiar form of insanity, in which the patient breaks out into paroxysms of alcoholic excess, attended with violent, strange, or even indecent acts, due to apparently uncontrollable impulses. The attack lasts a few days, and is succeeded by a long interval of sobriety and chastity. These patients have generally some hereditary taint; and not infrequently evidences, though often slight, of a morbid mental state may be detected in the intervals, if very carefully looked for. *See* Insanity, Varieties of.

Complications.—Most of these have been already described, but chronic drinkers are especially liable to pneumonia of a low type, and to acute phthisis. Delirium tremens is *very rarely* complicated with meningitis; acute alcoholic gastric catarrh may be followed by jaundice; and cerebral hæmorrhage may come on in a drunken fit. Temporary albuminuria is occasionally caused by the ingestion of large quantities of spirits, and even of beer.

Diagnosis.—The diagnosis of *acute* alcoholic gastric catarrh, of insanity from alcohol, and of oinomania depends on obtaining a true history. Acute alcoholic coma can only be diagnosed with certainty by emptying the stomach, and examining its contents. Mere odour of the breath is quite fallacious; and the writer attaches but little importance to the state of the pupils, or to the general features of the coma. Convulsions sometimes usher in the condition; and apoplexy may arise from the accidental rupture of a blood-vessel whilst a person is drunk. Opium-poisoning can only be satisfactorily eliminated by examining the contents of the stomach. Uræmic poisoning may be diagnosed by testing the urine, though here an element of uncertainty is introduced by the occasional occurrence of albuminuria in alcoholic cases; the presence of hypertrophy of the heart, of dropsy, of casts in the urine, or other changes typical of Bright's disease, must decide the question. Delirium tremens is occasionally separated with difficulty from some forms of insanity not caused by drink; but in the latter cases *delusions*, not mere terrors or hallucinations, are of primary importance. The delirium of acute fevers and pneumonia may be mistaken for delirium tremens; but the pyrexia, history of the case, and physical condition of the patient will guide to a correct diagnosis if the possibility of error be remembered. *Chronic* alcoholism has been mistaken for some chronic nervous affections, such as locomotor ataxy, chronic softening and multiple sclerosis of the nerve-centres, paralysis agitans, chronic tremors from metallic poisons, senile dementia, and commencing general paralysis. The correct history, and a careful examination of the patient, are especially important in diagnosing alcoholic paralysis from other nervous affections, especially from locomotor ataxy and lead-paralysis. In all these maladies, *special* symptoms are present, besides those common to them and to chronic alcoholism.

Prognosis.—In the acute forms of alcoholism the prognosis is favourable so far as the immediate attack is in question. In acute coma, the patient generally, but by no means invariably, rallies from the state of insensibility; but he may die from the supervention of a very rapid pneumonia. The prognosis in delirium tremens is favourable in young subjects; but its gravity increases with every attack, and with the co-existence of disease of the viscera, especially of the heart, liver, or kidneys. Patients with marked symptoms of fatty heart, or in whom pneumonia sets in, but rarely recover. Chronic alcoholism may be temporarily arrested; but the ultimate issue is unfortunately, as a rule, only too certain, for the habit is in most cases too strong to be broken off, or even to be checked for any lengthened period. Mental impairment, persistent tremors, ataxy, and signs of coarse brain-lesions, are especially significant of a speedy termination.

Treatment.—The *acute gastric catarrh* due to alcohol is most rapidly subdued by washing out the stomach with copious draughts of tepid water, and then giving a saline purge. All forms of alcohol should be rigidly abstained from; and the diet must be simple, and taken in a fluid form for a day or two. Passive exercise in the open air, or, if the patient be vigorous, a brisk ride on horseback, is very beneficial.

In cases of *acute coma* the stomach should be at once emptied by means of the stomach-pump. Cold affusion, followed by energetic friction and the application of bottles filled with warm water, so as to keep up the temperature, will generally revive the patient. Galvanism, in the form of the interrupted current, may often be employed with advantage. If the patient be strong, a smart purge, or, if weak, a milder one, will be all the after-treatment that is necessary.

Delirium tremens must be treated differently in the young and in the old. In first attacks in young, strong subjects, after a sudden debauch, complete abstention from alcohol, light and easily assimilated food (milk diet), moderate purgation, and occasionally tartarated antimony in doses of from one-twelfth to one-eighth of a grain, carefully watched, have been most efficacious in the writer's hands. If the patient has two or three restless nights in succession, bromide of potassium (thirty grains), or chloral hydrate (twenty grains), may be given, separately, or better in combination, at intervals of four hours, until sleep is procured, or sulphonal (thirty grains); but as the disease is spontaneously curable, sedatives must not be pushed. An experienced attendant should be always present, but no form of mechanical restraint is permissible. In older cases, a mild purge should begin the treatment; and light but very nourishing food should be administered at short intervals. Milk, beef-tea, raw eggs beaten up with milk, strong soups, and such articles are to be given freely; when, by careful management and good nursing, a very severe attack may be tided over, and natural sleep will return in from three to five days. The early administration of sedatives is to be deprecated; but should the restlessness persist, in spite of careful and assiduous feeding, a full dose of laudanum (♏xxx.—xl.) at bed-time is of great value. In the absence of albuminuria, lung-complications, or any sign of failure of the heart's action, the writer prefers this drug to other hypnotics. If the opium alone fail, its combination with an alcoholic stimulant (brandy, whisky, or stout) often succeeds. If there be any tendency to syncope, or if pneumonia should come on, as well as in cases complicated with shock, *e.g.* surgical injuries, a free use of stimulants is imperative. Hypodermic injections of morphine, and large doses of digitalis, are recommended by many authorities; but the writer has seen great harm attend their free exhibition. The cautious inhalation of chloroform vapour has occasionally cut short an attack by inducing sleep, but it much more frequently fails. Mechanical restraint is seldom, if ever, necessary, if the patient be properly nursed and attended to. All methods of self-destruction must be carefully guarded against. A padded room, when required and available, is of the utmost benefit.

The great desideratum in *chronic alcoholism* is to substitute an easily-digested and nourishing diet for the alcoholic stimulants, which can then be safely dispensed with altogether. The practitioner's judgment, and his knowledge of the *cuisine*, are very important in the management of these cases. Strong meat-soups, and good specimens of the concentrated preparations of meat, are of great value. The strictly medicinal treatment will consist in the administration of bitter tonics, such as nux vomica, quinine in small doses, calumba, or gentian; with carminatives, such as spirit of chloroform, armoracia, and capsicum. Alkalis, effervescent mixtures, and hydrocyanic acid are peculiarly useful if the stomach be irritable. The condition of the liver and bowels should be carefully regulated. Bromide of potassium is in general the best sedative to employ against the insomnia, though chloral hydrate is more certain; but the latter should only be given occasionally, lest the patient acquire the habit of frequently resorting to it. In long-standing cases, cod-liver oil, arsenic in small doses, and oxide of zinc have all done good, but they require a long and protracted administration. Phosphorus has been of no use whatever in the cases in which the writer has tried it; but small doses of the more easily assimilable preparations of iron are occasionally well borne, and are then most useful. The craving for drink, if urgent, may be checked by small doses of opium, but this drug must be exhibited with extreme caution. Judicious supervision, and, in inveterate cases, a residence in a proper asylum, are the only means from which any permanent benefit can be expected. Absolute abstention from alcohol cures almost every case of alcoholic paralysis, unless it has become quite hopeless; and massage and mild currents of electricity are of service in restoring the atrophied muscles. The treatment of insanity induced by alcoholism will not differ from that recommended in other forms, except in an enforced abstinence from its cause.

JOHN CURNOW.

ALEPPO EVIL.—*See* DELHI BOIL.

ALEXANDERSBAD, in Bavaria.—Chalybeate waters and hydropathic establishment. *See* MINERAL WATERS.

ALGID (*algidus*, cold).—A word implying extreme coldness of the body, used only when it arises in connexion with an internal morbid state, such as cholera, or a special form of malignant remittent fever.

ALGIERS. — Warm winter climate. Mean winter temperature 61° Fah., liable to rapid changes. Heavy rains not infrequent. *See* CLIMATE, Treatment of Disease by.

ALIMENT.—Food or aliment furnishes the elements required for the growth and maintenance of the organism; and, through its action with the other life factor—air, forms the source of the power manifested.

The aliment of organisms belonging to the vegetable class is derived from the inorganic kingdom. Under the influence of the sun's rays the elements of inorganic principles are appropriated in such a manner as to lead to the construction of organic compounds and meet the requirements of growth. This constitutes the main operation of vegetable life, and in it we have the source of the aliment of animals, which can only appropriate organic compounds, and which, either directly or indirectly, derive these compounds from the vegetable kingdom. As the solar energy employed in the construction of organic compounds, through the agency of the vegetable organism, becomes locked up in the compound formed, such compound represents matter combined with a definite amount of latent force. In the employment, therefore, of organic matter as aliment by animals, we have to look upon it not only as yielding the material required for the construction and maintenance of the body, but as containing and supplying the force which is evolved under various forms by the operations of animal life.

Aliment constituting the source from which the several elements belonging to the body are derived, it follows that, to satisfy the requirements of life, it must contain all the elements that are encountered. It is not, however, with the elements in a separate state that we have to deal, but with the products of nature in which they are variously combined.

The *alimentary products* as supplied by nature are resolvable by analysis into a variety of definite chemical compounds. These constitute the *alimentary principles.* Some are common to both animal and vegetable food, as, for instance, albumin, casein, fats, &c.; others are peculiar to either the animal or vegetable kingdom. Starch, for example, is met with only in vegetable, and gelatine only in animal products.

With reference to the alimentary principles, it must be understood that in no case do they exist in natural products in an isolated form, and no single alimentary principle is capable of supporting life. Although, however, it is with the alimentary products as a whole that we are practically concerned, yet, regarded from a scientific point of view, a knowledge of their constituent principles is required, to enable us to assign to them their proper value as alimentary articles; and for the purpose of systematic consideration some kind of classification is needed.

Classification.—Prout classified the constituent principles of food into four groups, which he named (1) the *aqueous*; (2) the *saccharine*; (3) the *oleaginous*; and (4) the *albuminous*. This classification is defective, inasmuch as it omits from consideration saline matter, which is equally as essential to nutrition as any other part of an alimentary product. The saccharine and oleaginous groups also stand as primary and independent divisions, whilst physiologically they are related, and may be conveniently considered under a combined heading.

Liebig proposed a classification based on physiological grounds; and, taking into account only the organic constituents of food, grouped them under the heads of (1) *plastic elements of nutrition*; and (2) *elements of respiration*. His *plastic elements of nutrition* comprise the nitrogenous principles; and to these he assigned the office of administering not only to the growth and renovation of the tissues, but also to the production of muscular and nervous power. Believing that the source of these powers sprang from the oxidation of the respective tissues, he held that the exercise of muscular and nervous action created a corresponding demand for nitrogenous alimentary matter, which thus became invested with an importance that led it to be regarded as affording a measure of the value of an alimentary article. By recent experimental research this view has been found to be untenable. The nervo-muscular organs are now looked upon as holding the position of instruments, by whose agency the force liberated by chemical action is made to manifest itself under certain other forms; and what is wanted for the purpose is simply oxidisable organic material, which may be derived from non-nitrogenous as well as nitrogenous food. The *elements of respiration*, or, as they were afterwards more appropriately styled, the *calorifacient principles*, represent the organic non-nitrogenous constituents of food. Their destination, according to Liebig, was heat-production. It is now maintained, however, as stated above, that they play a part in connexion with nervo-muscular action; and it may be also said that they are to some extent concerned in tissue-development. From the considerations set forth, Liebig's classification loses the scientific value it was at one time supposed to possess.

The following grouping of the alimentary principles, based on chemistry, furnishes a classification which involves no theoretical proposition, and is practically convenient:—

Food is primarily divisible into *inorganic* and *organic* principles.

The *inorganic* principles consist of water, and the various saline matters required by the system. They are as much needed for the support of life as the organic portion of food.

The *organic* principles are sub-divisible into *nitrogenous* and *non-nitrogenous*; and the *non-nitrogenous* are again further sub-divisible into *fats* and *carbo-hydrates*.

The *nitrogenous* principles contribute to the growth and nutrition of the various bodily textures, and furnish the active constituents of the secretions. They also undergo resolution in the system into urea, which is excreted; and a complimentary portion, which is susceptible of application to force-production. They are thus capable of administering to all the purposes fulfilled by the organic portion of an aliment.

The *fats* are applied to the production of heat and other forms of force. They seem also to be essential to tissue-development generally, besides yielding the basis of the adipose tissue.

The *carbo-hydrates* (starch, sugar, gum, &c.) contribute to the formation of fat, and are also applied indirectly, if not directly, to force-production.

There are a few principles, such as alcohol, the vegetable acids, and pectin or vegetable jelly, which do not strictly fall within either of the preceding groups. Alcohol occupies a chemical position intermediate between the fats and carbo-hydrates; whilst the others are more highly oxidised compounds than the carbo-hydrates.

All alimentary products in the form supplied by nature contain organic and inorganic principles, and the organic principles comprise more or less of the nitrogenous and non-nitrogenous divisions. The non-nitrogenous division, however, is not always represented, looked at broadly, by both fat and carbo-hydrate. Milk, which may be regarded, from the position it holds in nature, as furnishing a typical representation of an alimentary article, contains principles from each of the groups specified in the preceding classification. *See* Diet. F. W. Pavy.

ALIMENTARY CANAL, Diseases of.—*See* Digestive Organs, Diseases of; and the several organs.

ALIWAL NORTH, in Cape Colony.—*See* Africa, South.

ALKALINITY.—The reaction of human blood is always alkaline; and, though the normal degree of alkalescence has not yet been determined, it is probable that, like the temperature of the body, it is tolerably constant. In disease considerable variation, no doubt, occurs, but still the blood is always found alkaline. Pettenkofer and Voit found the serum of blood acid in a case of leukæmia some few hours after death, but not during life; and Sir Alfred Garrod states that in chronic gout the serum may become somewhat neutralised, but never acid. F. Hoffman has also found that the blood retains its alkalinity with great obstinacy: he fed pigeons for a considerable length of time on food yielding only acid ash, but the animals suffered from blood-poisoning before the alkalinity of the serum was neutralised. The alkalinity of the blood is maintained by the constant passage into it of the alkaline salts of the food, and of alkaline carbonates derived from the oxidation of the lactic, oxalic, and uric acids furnished by the disintegration of the tissues. The blood is probably prevented from becoming too alkaline by the withdrawal of its alkaline salts by the alkaline secretions, namely, the saliva, the bile, and the pancreatic fluid; whilst the acid salts, which, if accumulated, would tend to depress its normal alkalinity, are removed by the acid secretions, namely, the sweat, the gastric juice, and the urine, and by the exhalation of carbonic acid from the lungs. It has been shown that the withdrawal of acid by one secretion has a decided effect on the reaction of other secretions: thus the saliva becomes more alkaline during digestion, when the stomach is pouring out the acid gastric juice; and Dr. Bence Jones has shown that during digestion the acidity of the urine is lessened. A similar relationship is also shown to exist between the elimination of carbonic acid by the lungs and the acidity of the urine, the latter falling as the former is increased, and *vice versâ*. The importance of a proper degree of alkalescence for the blood is obvious, when we consider that this condition increases the absorption-power of its serum for gases, and is necessary to maintain its albumin in the liquid state, whilst oxidation is always more perfectly performed in alkaline solutions.

C. H. Ralfe.

ALKALIS. — Definition. — Inorganic substances, which turn syrup of violets green, and turmeric brown; and restore the blue colour to litmus which has been reddened by acids; they combine with acids to form salts; and their carbonates are soluble in water.

Enumeration.—The only substances which correspond with the above definition are—Potash, Soda, Lithia, and Ammonia. The alkaline earths—Lime, Magnesia, Baryta, and Strontia—and the alkaloids, have a similar action on vegetable blues and yellows; but the carbonates of the former group are almost insoluble in water; whilst the latter contain carbon, and are therefore classed with organic substances.

Properties.—Ammonia is distinguished from the other alkalis by its volatility. The non-volatile alkalis are readily recognised by their spectra; and by the colour they impart to the blowpipe flame, potassium giving it a violet, sodium a yellow, and lithium a carmine colour. Potassium and sodium are present as constituents of the body in considerable quantities; ammonium exists to a smaller amount; and lithium probably in traces. Sodium is found chiefly in the blood, potassium in the muscles.

Action.—When applied to the skin, dilute alkalis and their carbonates act as rubefacients. Pure ammonia is a vesicant, and potash and soda have a caustic action. Both caustic potash and caustic soda absorb water from the tissues, and form a corrosive fluid, which destroys the parts around, as well as that to which the caustic has actually been applied. To prevent this effect they are sometimes mixed with lime, which absorbs the water. A mixture of potash and lime forms the Vienna paste. When inhaled, ammonia causes irritation of the respiratory passages, and increased secretion of mucus. This irritation excites reflex contraction of the blood-vessels and consequent rise of blood-pressure. When swallowed in quantity, the caustic alkalis and their carbonates produce symptoms of irritant poisoning. In the case of ammonia these symptoms may be accompanied by those of inflammation of the air-passages, caused by the irritant vapour. The best antidote is dilute acid, such as vinegar. In small quantities and diluted, alkalis increase the secretion of gastric juice before meals. After absorption into the blood they render this fluid more alkaline; while potash appears especially to accelerate tissue-change, and is accordingly classed among the alteratives. When injected directly into the blood, potash acts specially on the muscles, which it paralyses. Ammonia stimulates the motor centres in the brain and spinal cord, the respiratory centre in the medulla oblongata, and the accelerating nerves of the heart. When injected into the veins it therefore causes convulsions like those of strychnine, and quickening of the respiration and pulse. Alkalis are chiefly excreted by the urine; and potash, soda, and lithia lessen its acidity, or render it alkaline. Ammonia is partly excreted unchanged, but a portion passes out in the form of urea and uric acid; and it does not render the urine alkaline like the others. Potash and lithia act as diuretics; soda to a less extent; and ammonia least of all. The diuretic action does not depend on any change in the blood-pressure. Potash and ammonia are diaphoretic. Potash lessens the tenacity of mucus.

Uses.—Dilute solutions of potash and soda relieve itching in skin diseases. Caustic potash or soda is used to destroy warts; to cauterise poisoned wounds and ulcers;

to open hydatid cysts in the liver; and to establish issues. Ammonia neutralises the formic acid which renders venomous the stings of bees, ants, and mosquitoes, and is therefore applied to relieve the pain which they cause. The intravenous injection of ammonia has been recommended as an antidote in snake-poisoning; but the value of the remedy is not established. Mixed with oil, so as to form a liniment, ammonia is used as a rubefacient in sore throats, bronchitis, rheumatic pains, and neuralgia. It is inhaled to relieve headache; as a restorative in syncope and shock, when it raises the blood-pressure; and to facilitate expectoration in chronic bronchitis. Alkalis administered after meals act as antacids, and relieve heart-burn. When given before meals they increase the secretion of gastric juice, quicken digestion, and relieve weight at the epigastrium, pain between the shoulders, and flatulence. Bicarbonate of sodium is usually given for this purpose, but when the stomach is very irritable, liquor potassæ is preferred, as it is considered to have a sedative action on the mucous membrane. Alkalis appear to lessen the transformation of glycogen into sugar, and they are used on this account in diabetes. Liquor potassæ sometimes helps to reduce obesity. Alkalis are used in the treatment of scrofula, rheumatism, gout, and lithiasis; but in the two last-mentioned diseases lithia is considered the most valuable, whilst potash is preferred to soda, as the urate of lithium is most soluble, and the urate of sodium least so. The salts of certain organic acids, such as the acetate or citrate, may be employed as remote antacids to render the urine alkaline, as they undergo combustion, and are converted into carbonates in the blood. Alkalis are given to lessen the acidity of the urine in inflammation of the bladder or urethra, and potash is employed as a diuretic in dropsies. On account of its stimulating action on the heart and respiration, ammonia is administered in adynamic conditions and in chronic bronchitis. T. LAUDER BRUNTON.

ALKALOIDS and other ACTIVE PRINCIPLES.—DEFINITION.—An alkaloid is a substance formed in the tissues of a plant or of an animal, having a definite composition as regards the proportions of the chemical elements of which it is composed, and capable of combining, like an alkali, with acids to form salts. All alkaloids contain nitrogen; and all, except conïne, nicotine, and sparteïne, contain oxygen.

Besides alkaloids there are other active principles found in plants, which have also a powerful influence on the animal economy, but do not possess all the chemical properties just stated.

CHEMICAL COMPOSITION AND RELATIONS.—These are briefly expressed in the above definition. Thus morphine, for example, one of the alkaloids of opium, has always the chemical composition represented by the formula $C_{17}H_{19}NO_3,H_2O$, and it may unite with acetic acid to form acetate of morphine, just as potash may unite with the same acid to produce acetate of potassium. But the empirical formula $C_{17}H_{19}NO_3$ represents only the percentage composition of the substance in the simplest numbers, and does not express how the atoms of the different elements are related to each other. For, just as ethylic alcohol, with the composition C_2H_6O, is believed by the chemist, from its behaviour towards other bodies, to contain a 'radicle,' or group of atoms, C_2H_5, having certain chemical properties resembling those of a base, such as potassium, K; and just as this radicle, C_2H_5, may replace one of the hydrogens of water, so as to form alcohol ($C_2H_5 + H_2O = \frac{C_2H_5}{H}O + H$); so chemists have good reason for believing that alkaloids belong to the group known as *amines* or *amides*, which are really ammonia, NH^3, in which one or more of the atoms of hydrogen are replaced by a radicle; in other words, they are ammonia bases, combining with HCl without elimination of H_2O. Most alkaloids are derivatives of pyridine.

It is obvious that two or more alkaloids may resemble each other in percentage composition, and still be very different, both in their chemical *structure*, and, necessarily, in their physiological action. Thus strychnine ($C_{21}H_{22}N_2O_2$), quinine ($C_{20}H_{24}N_2O_2$), and cinchonine ($C_{20}H_{24}N_2O$), differ only in a few atoms of carbon or of oxygen, more or less; but they have different physiological actions, showing that their chemical structure, which is not indicated in these formulæ, must also be different. The physiological action of an alkaloid may also be modified by combining it with another substance. Thus, as was pointed out by Crum-Brown and Fraser, compounds of strychnine with methyl, ethyl, and amyl, do not present the well-known physiological action of that substance, but one analogous to that of woorara.

ENUMERATION.—The alkaloids and other active principles most familiar to the physician are:—Morphine, Apomorphine, Narcein, Codeine, Thebaine, Narcotine, Papaverine; Atropine, Hyoscyamine, Hyoscine, Daturine; Nicotine; Conïne; Physostigmine or Eserine; Strychnine, Brucine; Quinine, Cinchonine, Cinchonidine; Beberine; Caffeine; Cocaïne; Theobromine; Aconitine; Veratrine; Digitalin; Curarine; Muscarine; Santonin; Ergotin; Emetine; Pilocarpine; Salicin; and Strophanthin. For the alkaloidal substances formed in dead bodies and in animal tissues, *see* PTOMAÏNES.[1]

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[1] Names of alkaloids are now made to end in *ina* (Latin) or *ine*—thus: morphina or morphine. The names of *non*-alkaloidal active principles terminate in *inum* (Latin) or *in*—thus: digitalinum or digitalin.

Sources.—The majority of alkaloids are formed by plants. The function which they subserve in the economy of the plant is not known. Some plants produce only one alkaloid, while in others two or more are formed. A few of the alkaloids have been produced synthetically by the chemist.

Physiological Action.—Alkaloids have various degrees of physiological activity when introduced into the animal body. Many are slow in their action, and a large dose is required to produce any observable effect; while others act more rapidly, and are so potent that even a minute dose may destroy life. Compare, for example, narcotine, one of the alkaloids of opium, with nicotine, the alkaloid of tobacco. Twenty to thirty grains of the former have been taken by the human subject without producing any marked symptoms, while the twentieth part of a grain of the latter may induce symptoms so severe as to threaten death. It is also well known that alkaloids may have a different kind of action on different animals. Thus one-fourth of a grain of atropine will produce serious symptoms of a complex character in a dog, while three or even four grains may be given to a rabbit without causing any more marked effect than dilatation of the pupil. In considering the physiological actions of these substances, the following generalisations may, in the present state of science, be made tentatively:—1. As a general rule, the more complex the organic molecule, and the greater the sum of its atomic weight, the more intense will be the action of the substance. 2. Substances which split up quickly into simpler bodies produce rapid but transient physiological effects; whereas substances which resist decomposition in the blood or tissues may produce no appreciable results for a time, but when they do begin to break up, the effects are sudden and violent, and usually last for a considerable time. 3. Alkaloids have frequently a double action on different parts of a great physiological system; and their action in a particular group of animals will depend on the relative degree of development of the parts of the system in that group. Thus most of the alkaloids of opium have such a double action—a convulsive action resembling that of strychnine, due to their influence on the spinal cord or on the motor centres in the brain; and a narcotic or soporific action resembling that of anæsthetics, due to their influence on sensory centres in the brain. Hence, in animals where the spinal system predominates, as in frogs, these alkaloids act as convulsants; while in the higher mammals their principal action is apparently on the encephalic centres, which have now become largely developed.

Passing to the consideration of the action of the individual substances, we cannot do more than give, by way of example, a brief *résumé* of our knowledge regarding a few of them.

1. **Morphine** ($C_{17}H_{19}NO_3$)—an alkaloid of Opium. In the frog this substance has an action resembling that of strychnine. At first there is a state of agitation, followed by tetanic spasms; finally, all reflex actions, including those of the heart and of respiration, are paralysed. Pigeons have been found to possess a remarkable power of withstanding the influence of this drug—an ordinary sized bird requiring about two grains to kill it. Rabbits become partially somnolent, show a tendency to reflex spasms, and tolerate a large dose—say about one-half to one grain per pound weight of the animal. In the dog the intravenous injection of even one-tenth of a grain (for a small animal) causes agitation followed by sleep; the pulse and respiratory movements are slowed; the smaller arteries become (at least during one stage) contracted, so as to cause an augmentation of general blood-pressure; the pupil is contracted; and, if the dose be large, death may be preceded by convulsions. In the higher mammals morphine acts chiefly on the sensory apparatus, both peripheral and central.

2. Other alkaloids of opium have also been investigated:—(*a*) **Narcein** ($C_{23}H_{29}NO_9$) is a pure hypnotic, causing profound sleep. Even in large doses it does not produce convulsions. (*b*) **Codeine** ($C_{18}H_{21}NO_3$) has an action mainly like that of morphine. (*c*) **Thebaine** ($C_{19}H_{21}NO_3$) causes tetanic convulsions, thus resembling strychnine. (*d*) **Narcotine** ($C_{22}H_{23}NO_7$) is slightly narcotic, but strongly convulsant. (*e*) **Papaverin** ($C_{20}H_{21}NO_4$) causes a somniferous action like that of narcein. It is evident, therefore, that opium, which may contain more or less of all of these substances, must have an action on the body of a very complicated character.

Apomorphine ($C_{17}H_{17}NO_2$), a derivative of morphine, has none of the characteristic actions of that substance, but acts chiefly as a vascular depressant and as an emetic.

3. **Strychnine** ($C_{21}H_{22}N_2O_2$)—the alkaloid of Strychnos nux vomica. In the frog very minute doses cause convulsions of all the voluntary muscles, excited by peripheral irritation. These convulsions are due to the action of the poison on the spinal cord, as they persist after decapitation. In warm-blooded animals the reflex character of the convulsions is less evident; they have more of a tonic character, and chiefly affect the extensors. The exact *modus operandi* of the poison on the cord is unknown, but in some way or other it heightens its reflex sensibility. Death is usually the result of asphyxia from arrest in spasm of the respiratory mechanism, but it may result from exhaustion. **Brucine** ($C_{23}H_{26}N_2O_4$), another substance found in nux vomica, appears to have an action like that of strychnine, but more feeble.

4. **Atropine** ($C_{17}H_{23}NO_3$)—the chief alkaloid of Atropa belladonna. In the frog it causes tetanic reflex spasms. Herbivorous animals,

as a rule, have a tolerance of this poison, so that its effects are best studied in carnivora. Even in these the action is somewhat uncertain. Respiration may be paralysed without general convulsions; the pulse is quickened, from paralysis of the inhibitory action of the pneumogastric nerve on the heart; and the arterial pressure is increased. After very large doses the arterial pressure may be diminished, with paralysis of all parts containing involuntary muscular fibre. Secretion is diminished. The pupil is dilated—apparently by a direct influence of the poison on the centres or nervous arrangements in the iris itself, as the effect may be observed even in an eye removed from the head. **Hyoscyamine,** and **Hyoscine,** the alkaloids of Hyoscyamus niger, and **Daturine,** the alkaloid of Datura stramonium, have actions allied to the action of atropine.

5. **Digitalin** ($C_{27}H_{44}O_{15}$)—the so-called active principle of Digitalis purpurea, probably a mixture of several bodies. A large dose causes slowing of the heart. If the dose be increased, the heart is arrested in diastole, and will not respond to direct excitation. With medium doses there is a period of acceleration of the heart, but this period may rapidly pass into that of slowness just mentioned. This effect on the heart has not yet been clearly accounted for, and it remains to be decided whether it be due to the influence of the drug on the terminations of the pneumogastric, or of the sympathetic, or on the intracardiac ganglia themselves. Coincident with the action on the heart, the smaller arteries are contracted, and the arterial tension is increased. Digitalis would appear to have little effect on involuntary muscle, but it exerts a potent action on voluntary muscle, which, after small doses, becomes feeble in contractile power, while large doses may abolish contractility altogether.

6. **Physostigmine, or Eserine,** ($C_{15}H_{21}N_3O_2$)—the active substance of Physostigma venenosum, or Calabar bean. As has been pointed out by Professor Fraser, this alkaloid has an action antagonistic to that of atropine. Sensibility and consciousness remain until death; the voluntary muscles are paralysed; involuntary muscles are said to show tetanic contractions; respiration is at first accelerated, and afterwards slowed; the vessels become alternately dilated and contracted; secretion, especially that from the lachrymal and salivary glands, is increased; and the pupil is contracted. Physostigmine appears to paralyse the anterior cornua of the spinal cord.

7. **Curare**—a resinous substance, containing an alkaloid, **Curarine,** of the composition $C_{10}H_{15}N$, obtained from certain parts of South America, and used by the natives of these regions as an arrow-poison. It is probably obtained from certain plants belonging to the genera Strychnos and Paullinia. Its distinctive physiological action is abolition of the power of all voluntary movement, in consequence of its action, as was proved by Claude Bernard, upon the peripheral terminations of motor nerves—the 'terminal plates' of muscle. Respiratory movements are arrested as the result of paralysis of the muscles of respiration, but the heart may continue to beat for a considerable time. If artificial respiration be established, the circulation may be maintained for several hours, while the animal is completely under the influence of the substance. All the secretions are increased, and the mean temperature falls.

8. **Muscarine**—the alkaloid of Agaricus muscarius. It causes arrest of the heart's action in diastole, an effect which may be removed by the influence of atropine, thus affording an instance of physiological antagonism. In warm-blooded animals muscarine slows the heart's action; the blood-pressure falls; respiration is first embarrassed, and may be completely arrested; parts containing involuntary muscle are in a state of tetanic spasm; the pupil is contracted; and secretion is increased.

9. **Santonin** ($C_{15}H_{18}O_3$)—the neutral crystalline principle of Artemisia maritima. This drug may cause nausea, vomiting, hallucinations, vertigo, and a peculiar state of visual sensation—the field of vision usually appearing yellow, but sometimes violet. It is said that the stage of violet rapidly passes into that of yellow, and therefore it is probable that santonin may first excite the retinal fibres sensitive to violet (according to Thomas Young's theory of colour-perception), and afterwards paralyse them. In large doses, santonin causes loss of consciousness, tetanic convulsions, and death.

10. **Ergotin**—the so-called active principle of Ergot. It causes contraction of the smaller blood-vessels, contractions of the uterus, and slowing of the pulse; and the animal may die in consequence of arrest of the action of the heart.

11. **Quinine** ($C_{20}H_{24}N_2O_2$)—one of the alkaloids of Cinchona. In small doses quinine accelerates the heart in the warm-blooded animal; in moderate doses it slows it; and in large doses it may arrest it, and cause convulsions and death. Research shows that its action is essentially upon the central nervous system. It destroys all microscopic animal organisms, apparently killing vibrios, bacteria, and amœbæ; but it seems to be without action on humble organisms belonging to the vegetable kingdom. It arrests the movements of all kinds of protoplasm, including those of the colourless corpuscles of the blood. It arrests fermentative processes which depend on the presence of animal or vegetable organisms, but it does not interfere with the action of digestive fluids.

12. **Nicotine** ($C_{10}H_{14}N_2$)—the alkaloid of Tobacco. It stimulates and then paralyses

the secretory nerves of glands, and also the nerves of involuntary muscles. It causes cold sweats, a feeble circulation, and fainting; a large dose causes death by failure of respiration, attended by severe convulsions. The blood-pressure falls at first, but it may then rise, and the pulse-rate is rapid. Nicotine first stimulates and then paralyses the ends of the vagi in the heart.

13. **Cocaine** ($C_{17}H_{21}NO_4$) — from Erythroxylon coca. This is a local anæsthetic, acting on the terminations of the nerves of the skin and of mucous membranes. Its general action resembles that of caffeine, in small doses lessening fatigue, in larger doses causing weariness, deafness, and inability to think clearly. Its action is first on the cerebrum, then on the medulla, and lastly on the spinal cord. Very large doses may cause convulsions, of cerebral origin, or due to paralysis of the respiratory centre; the sensory columns of the cord are paralysed, while the motor are unaffected. Small doses raise the blood-pressure and quicken the pulse; large doses have the reverse effect. The secretions are generally diminished.

14. **Pilocarpine** ($C_{11}H_{16}N_2O_2$) — from Pilocarpus pennatifolius or Jaborandi. Pilocarpine stimulates the secretory nerves of glands, causing especially copious secretion from the salivary and sweat-glands. It also increases the secretion from the bronchial mucous membrane, from the glands of the stomach and intestines, and from the kidneys. It does not increase the secretion of bile, and its action on the mammary gland is uncertain. In large doses it may cause unsteadiness of movement, with a tendency to rotate, twitchings of muscles, shivering, and dyspnœa, showing an action on nerve-centres. In these circumstances the pupil is contracted, and there is indistinct vision, from spasm of the ciliary muscle. Large doses paralyse the vagus endings in the heart, and there may also be spasmodic contractions of the muscular walls of the stomach, intestines, and bladder. During profuse sweating the temperature rises. There may be death from sudden collapse.

15. **Strophanthin** ($C_{16}H_{26}O_8$?) — the active principle of Strophanthus hispidus. It resembles digitalin in its general action: it stimulates all striated muscles; in large doses, it may arrest the heart in systole; and it also acts as a diuretic.

John G. McKendrick.

ALLANTIASIS (ἀλλᾶς, forced meat).—Sausage-poisoning. *See* Poisonous Food.

ALLEGHANY SPRINGS, in Montgomery county, Virginia, U.S.A.—Calcic or earthy waters. *See* Mineral Waters.

ALLEVAUD, in France (Isère).—Sulphur waters. *See* Mineral Waters.

ALLOCHIRIA (ἄλλος, another; and χείρ, the hand).—A peculiar disturbance of cutaneous sensibility in which a tactile sensation is referred to another part of the body than the seat of actual impression; or to a corresponding part of the opposite side of the body. *See* Sensation, Disorders of.

ALOPECIA.—*See* Baldness.

ALOPECIA AREATA (ἀλώπηξ, a fox). Synon.: *Area; Alopecia circumscripta; Porrigo decalvans.* Fr. *Alopécie*; Ger. *Fuchsräude.*

Definition.— A non-contagious atrophic disease of the hair, distinguished by the rapid development of more or less circular bald patches; in rare cases the baldness is general.

Symptoms.—Alopecia areata is most common on the scalp, and is generally limited to that region, the occiput being the part most frequently affected. In some instances the beard and eyebrows suffer, and in very rare cases the whole of the hair is lost. Alopecia areata is usually confined either to a single round, perfectly bald spot, or to several spots irregularly scattered about the scalp; when, however, the disease attacks the occiput, it is often roughly symmetrical. The same remark applies to the eyebrows and eyelashes, and to all very severe cases, which have a strong tendency to become symmetrical. A characteristic feature of the disease is the rapidity with which the hair falls off over a limited area, leaving very few, if any, stumps on the bald patch, which is bounded by hair of apparently natural growth. When, however, the hair round the area comes out very easily, it may safely be predicted that the spot will increase in size. The part affected is sometimes pinker than the surrounding skin, but much more commonly it is of the same colour, or paler. There is sometimes a slight atrophy of the skin, as well as of the hair, so that the area has a shallow, cupped character; this is comparatively rare, and therefore cannot be due simply to the loss of hair.

Ætiology and Pathology.—The causes of alopecia areata are not known. The immediate origin of the disease is probably some nerve-disturbance, leading to atrophy of the roots of the hair and sometimes of the skin. This view is confirmed by the fact that there is occasionally, though rarely, a temporary loss of sensibility over the area; and even when this is not the case, the skin is less sensitive to irritants than is normal. Sometimes the loss of hair is preceded by neuralgic pains, or tenderness on pressure, but more commonly there are no subjective sensations. The disease is rather more common in childhood and youth than in middle life, while it is seldom seen in old age; the writer has, however, met with one case in a man over seventy years of age, who completely recovered. Alopecia is probably equally common in males and females, though on this point there is some difference of opinion. The old idea that the disease was due to a parasitic fungus has now been given up, in consequence of the complete failure of all attempts to demonstrate the fungus; moreover many of the clinical features of the disease, especially its great liability to recur after complete absence for perhaps years, is not at all in accordance with a parasitic origin. There is certainly sometimes a family tendency to alopecia. In extreme cases of alopecia areata, in which all the hair is lost, the nervous origin of the disease is generally admitted.

With regard to its morbid anatomy, it may be said that it is often difficult to find stumps, but when present they are very characteristic. They are also sometimes valuable for the purpose of differential diagnosis, since they are unlike the stumps of ringworm, being straight and thicker at the free end than at the point of insertion, which is contracted into a sort of neck, ending in a small, rounded, atrophied root. A very slight amount of traction removes them entire; in this respect they differ much from ordinary ringworm stumps.

Diagnosis.—Ringworm is the only disease which is liable to be mistaken for alopecia areata. The difficulty arises thus: in common ringworm, either from treatment or from some other unknown cause, the hair sometimes falls rapidly off instead of breaking as it usually does. When the hair comes out in this way, with root attached, a smooth bald spot is left, exactly like alopecia areata; under these circumstances, unless a stump can be obtained for examination, the diagnosis is very difficult. The presence of other cases of ringworm in the same house, and the history of the patient, may be a guide to diagnosis.

Dr. Crocker mentions a very interesting and instructive series of cases of 'eight children in one family, who, while at the seaside, had each a few small perfectly bald spots on their heads; they were quite bare from the first, and never larger than half-an-inch in diameter.' After a time the governess contracted the disease, which was believed by her doctor to be alopecia areata, and not contagious; she, however, slept with her sister, who afterwards showed similar spots. Dr. Crocker says: 'The hairs round were loose: there were no short hairs, but one pulled out of the border showed distinct fungus-elements, indistinguishable from tinea tonsurans. In no case were there more than three spots, and they were all small. In one child there was a history of a red ring on the side of the cheek.' The writer has himself met with three similar examples. The first was in a school of about forty-five girls, where there were upwards of twenty girls affected with small bald spots on the head, mostly free from stumps; there were, however, in a few cases a sufficient number of stumps full of ringworm fungus to make the diagnosis certain. The medical officer to the school correctly diagnosed ringworm, although the appearance of most of the children would have deceived anyone had the *cases occurred singly*. The second instance was in a boys' school, in which sixteen or seventeen cases of bald spots on the head occurred. The writer saw in the first instance only two boys, who were sent to him before it was known that any others in the school were affected. Both boys had small bald spots like area, but on one of the spots were ringworm stumps. The writer recommended that all the boys in the school should have their heads examined; this was done, and then many others were found to have bald spots. He subsequently saw one or two other boys from the same school with bald spots, which he had no doubt, under the circumstances, were ringworm. In this instance the disease had been called alopecia areata, and pronounced not contagious. The third case was in a family of children.

There is one point especially worthy of notice in all these curious outbreaks of *bald ringworm*: the spots were for the most part small, and by no means always circular at the margin, like area. On the contrary, some of the spots were angular, and others narrow and long like scars; indeed the shapes of the bald spots were in most cases not like those of typical area, although in every other respect there was a very close resemblance, so that it would be almost impossible to diagnose an isolated case as tinea tonsurans, unless some of the affected hairs remained. A favourable point in these cases is that when the hairs have all been shed, the risk of further contagion is much diminished; on the other hand, the disease spreads very rapidly *at first*, for every hair that is shed is a centre of infection.

Treatment.—The prognosis in most cases of alopecia areata is favourable, but the disease is very tedious. The treatment is partly local and partly general; the local treatment consists in the application of stimulating remedies to the bald patch, of which the best is cantharides. The acetum cantharidis, diluted with one or two parts of spirit, and painted on daily with a camel's-hair brush, answers very well. The lotion used should not be strong enough to blister, because its daily use cannot then be continued. Of ointments, the chrysophanic acid is the most useful, but it is disagreeable. The general treatment should consist of suitable tonics, and wine or beer, with plenty of rest and change of air. Continued physical fatigue appears in many cases to favour the development of alopecia areata.

Robert Liveing.

ALPHOS and **ALPHOIDES** (ἀλφὸς, white).—Terms signifying white and white-looking, associated with the whiteness of the discs of common psoriasis: hence *lepra alphos* and *lepra alphoides*. *See* PSORIASIS.

ALPHOSIS (ἀλφὸς, white).—Whiteness, or the process of turning white. *See* ACHROMA.

ALTERATIVES.—DEFINITION.—Medicines which gradually restore the nutrition of the body to a healthy condition, without producing evacuations, or immediately exerting any very evident action upon the nervous system.

ENUMERATION.—The principal alteratives are—Nitric and Nitro-hydrochloric acids; Chlorine and Chlorides; Iodine and Iodides; Sulphur and Sulphides; Potassium and its salts; Mercury and its salts; Phosphorus and Hypophosphites; Antimony; Arsenic; Taraxacum; Sarsaparilla; Hemidesmus; Guaiacum; Colchicum; and Mezereon.

ACTION.—Healthy nutrition depends on the digestion of the food, its assimilation by the tissues, the decomposition of the tissues during the exercise of their functions, and the removal of their waste products being performed in a proper manner—in due proportion one to another. If the food is not properly digested, as in dyspepsia; or is not properly assimilated, as in diabetes; if the tissues break up too rapidly, as in fever; or if the waste products are not properly removed, as in some cases of kidney-disease, nutrition suffers. Digestion and excretion may be improved by tonics, purgatives, and diuretics; but alteratives seem to exert their action upon assimilation and tissue-change. The digestion of food is effected by means of ferments, such as those of the salivary glands, stomach, pancreas, &c. Some also of the changes, such as the conversion of glycogen into sugar, which the food undergoes after absorption in the liver, and even certain so-called vital actions—such as the coagulation of the blood—are produced by a similar agency. It is not improbable that the histolytic changes in the tissues are also effected by ferments. They do not depend upon oxidation, for although during health the products of tissue-decomposition are oxidised as fast as they are formed, yet under certain circumstances the tissues are split up so rapidly that the products which they yield are only partially oxidised. This is seen in poisoning by antimony, arsenic, and still more markedly by phosphorus, where such tissues as the muscles become decomposed, yielding nitrogenous substances, such as leucin, tyrosin, or urea, and fat. The former are excreted in the urine; while the last, instead of undergoing combustion, accumulates in the place formerly occupied by the muscular tissue, which is accordingly said to be in a state of fatty degeneration. It is possible then, although by no means certain, that alteratives influence nutrition, either by modifying the activity of ferments, or by altering the susceptibility of the tissues to their action.

Mercurials in purgative doses, taraxacum, nitric and nitro-hydrochloric acids, probably act by modifying the digestion of the food in the upper part of the small intestine, or by affecting the changes which it undergoes in the liver after absorption. Potash has probably an action on the muscles. Antimony, arsenic, and phosphorus especially affect the nervous and cutaneous systems. Mercury has a peculiar power of breaking up newly-formed fibrinous deposits, and particularly syphilitic growths. Iodine, iodides, and probably chlorides, act upon the lymphatic system and promote absorption.

USES.—Purgative doses of mercurials, taraxacum, nitric and nitro-hydrochloric acids are useful in cases of frontal headache, general malaise, and depression of spirits, associated with symptoms of so-called biliousness, or with the appearance of urates or of oxalates in the urine. Potash and colchicum are employed in the treatment of gout. Phosphorus and arsenic are used in cases of nervous debility, as well as in nervous diseases, such as neuralgia and chorea, in which antimony is also serviceable. Arsenic is also given in diseases of the skin; and antimony in inflammation of the mucous membrane of the bronchi. Mercury in alterative (that is, small) doses, which are absorbed into the circulation without purging, is used to break up newly-deposited fibrinous masses, as in iritis, pericarditis, &c., and to counteract the effect of syphilitic virus upon the soft tissues in the secondary stage of this disease. Iodine and iodides act on the lymphatic system, and are useful in removing glandular swellings. By stimulating the absorbent system they may also assist in the removal of the fibrinous deposits and syphilitic growths disintegrated by mercury. The iodides are sometimes given in the secondary, but are still more valuable in the tertiary, stage of syphilis.

T. LAUDER BRUNTON.

ALVENEU, in Switzerland.—Sulphur waters, and chalybeate water, with iodine and common salt. *See* MINERAL WATERS.

ALVEOLAR.—A word used in pathology as descriptive of any morbid growth which consists of small cavities or spaces (*alveoli*), usually occupied by contents, and bounded by walls formed of cells or fibres. Alveolar cancer is the most familiar application of the term, being a synonym for colloid cancer. *See* CANCER.

AMAUROSIS (ἀμαύρωσις, a darkening or dulling of the sight.)—DEFINITION.—This term cannot be strictly defined. Literally, it means an *obscurity of vision*, a state of *blind-*

ness, in the popular sense of the term, whereby nothing more is learnt than that the patient cannot see well enough for practical purposes, and is thereby unfitted for the usual occupations of life. Besides this, it is always tacitly understood that an external observation of the organ of vision, during the life of the patient, does not reveal any ostensible cause of blindness. It is further understood that the use of glasses is no remedy in amaurotic cases. It is rather the kind, than the degree, of blindness that is called amaurotic; but it must be observed that lesser degrees of blindness, of the amaurotic type, are generally, vaguely and indefinitely, called *amblyopic*.

ÆTIOLOGY.—The causes of amaurosis have been more recently specifically attributed to morbid conditions of the percipient nervous apparatus of the eye. All cases are excluded in which, in the present state of science, and using the ophthalmoscope, we can *see* any morbid condition. But very few cases are now, in the statistical tables of the chief eye-hospitals, included under the head *amaurosis*. Some few cases seem likely, at least for some time to come, to be called by this term. The ophthalmoscope has enabled us more accurately to classify a large majority of the cases formerly called amaurotic. Many new names are thus employed whereby we gain more definite information. If only, as in *some* of them (*e.g.* 'white atrophy'), we have substituted the name of a particular ophthalmoscopic sign for an indefinite symptom, at least we can speak more accurately of the part that is or has been diseased—of the retina, or of the ocular end of the optic nerve.

In a large majority of the cases commonly classed as those of amaurosis, it is found ophthalmoscopically that there is 'white atrophy' of the optic nerves. The 'discs' are nearly or quite bloodless—white, not pinky-white; and the nerve-fibres going to the retinæ, being more or less wasted, there is some excavation of the discs, perhaps so much that the lamina cribrosa, in one or both, is exposed to view, while the retinal vessels are somewhat diminished in size. The causes of this condition are, most commonly, intracranial tumours or other diseases which induce pressure upon the optic nerve, or lead to an extension of inflammation, followed by œdema or double optic neuritis (descending), these terminating in the atrophy and amaurosis. The nerve-disease is often due to syphilis. But some cases of white atrophy occur in which there has been no precedent neuritis. Of such 'tobacco amaurosis' is an example, in which, unless smoking be given up, by an idiosyncrasy of the patient, he soon becomes blind. But nerve-atrophy or inflammation should be no longer called amaurosis—they have obtained a better nomenclature. The preceding stages of the diseases causing them, if, as is rarely the case, unaccompanied by any definite ophthalmoscopic signs, and yet producing a considerable amount of blindness, may, for want of better knowledge, at present be called *amaurotic*. Other such cases include those reported as snow-blindness; those in which blindness has been produced by a lightning-flash near the eye or by a blow on the eye without other mischief resulting; disuse of an eye in children, as in some neglected squint cases; irritation from some branches of the fifth nerve (dental caries, &c.); anæmia after excessive losses of blood; suppression of menses; blood-poisoning by tobacco, lead, quinine; uræmia; and some cases of cerebral apoplexy. Embolism of the central artery of the retina occurs, but it is easy of diagnosis with the ophthalmoscope, and therefore should not be called amaurotic. The writer does not think there are any cases of *long-standing* blindness that show no ophthalmoscopic changes

SYMPTOMS AND DIAGNOSIS.—There is one symptom of amaurotic blindness, affecting both eyes, which is noteworthy, as constituting, *primâ facie*, a general distinction between it and the other cases of blindness *not* of nervous origin: the gait and general aspect of the patient are peculiar—he is hesitating and hopeless-looking. He no more *tries* to see objects. He holds up his head; the eyes are open and turned upwards. He feels his way with his feet, and his hands are extended before him. He does not look towards you, or at anything in particular. But amaurosis does not by any means imply a similar state of vision in both eyes, nor that the blindness is to be taken in the ophthalmological sense, *i.e.* wanting perception of light. It would be well if any less degree of imperfection of vision, without evident cause, might be called *amblyopic*, but the two eyes must be considered separately.

To diagnose the absence or presence of a power of perception of light, the patient should be placed opposite to a bright light, such as a gas-lamp, and near to it, but not so near that he can feel the heat of it; the light is then turned up and down, and it is fully exposed and obscured, and the patient is asked many times, in quick succession, if he sees light or not. Any other blindness than this of absolute amaurosis, or originating in any other diseases than those of the percipient nervous apparatus of the eye, is never so great as to prevent the perception of light. If the patient can distinguish light from darkness, we next test whether he can see shadows of some small objects—of the hand, or of one finger only, passed between him and the burning light, or the light of the window only. If he can see to count fingers, his blindness is insufficient to indicate what is called amaurosis. Another point in the diagnosis of amaurosis is that, ophthalmoscopically, the appearance of the fundus of the eye is normal, or such as, independent of errors of refraction, we find in other cases compatible with standard vision, or at least with a fair amount of useful vision. This will allow of a considerable latitude, and will not include any slight or imaginary hyperæmia or anæmia of the optic disc, any physiological excavations of the same, or congenital opacities of the retina. The pupil of the affected eye is, if the other be perfectly excluded from light or vision, nearly always dilated to almost the greatest extent, though atropine dilates it yet more fully; and it is fixed, being insensible to light.

Prognosis.—After a due consideration of the cases thus classed together—and they are very unlike in fact, and often very obscure—we may say generally, that if the blindness be of one eye only, sudden and recent, the prognosis is hopeful; but if both eyes are affected, and the disease, whatever it may be, is of steady progress and of long standing, it is very serious. The cases of amaurosis are very rare indeed in which vision is perfectly restored; most of them end fatally to vision, or would so end but that the disease is sooner fatal to life.

Treatment. — This must necessarily be varied according to the cause of the amaurotic condition. For instance, if there is intracranial disease, treatment directed thereto must be followed out; and should there be indications of syphilis, iodide of potassium and small doses of mercury must be given for some time. When amaurosis depends on any injurious habit, such as smoking, this must be relinquished. Large doses of strychnine and iron are useful in advanced white atrophy.

J. F. Streatfeild.

AMBLYOPIA (ἀμβλυωπία, dim-sightedness).—Obscurity of vision. *See* Amaurosis.

AMBULANCE (*ambulo*, I move about).
Synon.: Fr. *Ambulance*; Ger. *Feldlazareth.*

Definition.—A term adopted from the French word, which signifies the movable hospital of an army.

The use of an ambulance is to convey from place to place those who are sick, wounded, or otherwise incapable of moving.

Description.—An ambulance consists of a *vehicle* or caravan, upon or within which one or more *stretchers* can be laid or fixed.

Stretchers.—It is important that stretchers should be of uniform pattern, so as to admit of easy transference from one carriage to another. Each stretcher consists of two poles kept apart by metal traverses, supporting a canvas stretched between. The length of a stretcher (7 ft. 9 in.) is often inconvenient when conveying a patient through passages or up staircases. To obviate this difficulty, the poles of stretchers used for civil ambulances should be made of metal tube capable of being telescoped.

The *vehicles* or carriage-frames are of two kinds: (1) those for *hand ambulances*; and (2) those for *horse ambulances.*

1. *Hand ambulances*, or litters, of which there are several varieties, consist of a skeleton carriage, firmly supported on easy springs, and provided with two, three, or four wheels.

Upon a framework thus formed, the stretcher fits, and is immovably fixed by straps or bolts. The carriage is made with a view to convenience of size and lightness of structure, consistently with strength. Facility in turning should be secured. A complete covering or hood protects the patient from exposure. In all ambulances special care should be taken, by springs and other contrivances, to prevent the suffering caused by jolting.

2. *Horse ambulances* are used for (*a*) civil, and (*b*) military purposes.

(*a*) The first of these, as used in towns, are drawn by one horse. They usually consist of coaches which are unlined, so as to allow of washing and complete disinfection. One or two doors are placed behind, through which a stretcher or bed may slide on to a shelf, occupying about one lateral half of the interior of the coach. A seat for an attendant completes the fittings.

Ambulances for civil purposes should be easily obtainable at hospitals, police-stations, and other recognised centres.

(*b*) *Military ambulances*, more commonly termed ambulance waggons, consist of a wood-framed body provided with a cover, curtains, and hood of canvas extended on a skeleton-framed roof. They carry likewise a reservoir for water. These ambulances are drawn by two or more horses. In the English army they are arranged to carry two patients on stretchers, and five others less seriously injured, two in front and three behind. In the German army they accommodate four stretchers—two on the floor of the waggon, and two on a plane above—besides five other persons slightly wounded.

Ambulance Field Hospital. — Captain Tomkins, of the Victoria Rifles, and the writer have designed an ambulance waggon which supports on its exterior a folding double tent 35 × 22 feet. Twenty folded stretchers, each convertible into a bedstead, one foot high by two feet two inches wide, line the sides of the waggon. There are also provided the requisites for twenty beds, surgical instruments and appliances, a furnace for cooking and for warming the tent in winter, together with rations for three days. This arrangement obviates the necessity for assistance from the main army.

For this Hospital the Empress Augusta Prize and Gold Medal for prompt assistance to the wounded on the field of battle were awarded.

A. T. Norton.

AMBULANT (*ambulo*, I move about). Moving, unfixed, shifting. Applied to diseases that shift from one part to another, such as erysipelas; in connexion with blisters applied in succession to different parts of the body, also called 'flying blisters'; and to moving or 'field' hospitals, as distinguished from fixed or 'base' hospitals.

AMBULATORY (*ambulo*, I move about).—A term used in connexion with mild or latent cases of acute diseases, in which the patient continues to walk about, or work, up to a late period of the attack, as in typhoid fever—*typhus ambulans s. ambulatorius.* *See* Typhoid Fever.

AMELIE-LES-BAINS, in France (Pyrenees).—Thermal sulphur waters and climatic health-resort. *See* Mineral Waters, and Climate, Treatment of Disease by.

AMENORRHŒA (ἀ, priv.; μήν, a month; and ῥέω, I flow).—Absence of the menstrual flow during any portion of the period of life when it ought to be present. *See* Menstruation, Disorders of.

AMENORRHŒAL INSANITY.—*See* Insanity.

AMENTIA (ἀ, priv.; and μένος, the mind).—An obsolete term for dementia. *See* Dementia.

AMNESIA (ἀμνησία, forgetfulness; Fr. *Amnésie*; Ger. *Gedächtnisswache*).—A general term signifying loss or defect of memory; commonly, however, used in reference to one particular class of defect of memory, viz., that for words (*amnesia verbalis*). Sometimes there is a mere forgetfulness of proper names; sometimes a substitution of wrong words; at other times the pronunciation of a meaningless jargon, not at all representing words. The production of these defects is due to disease in different parts of the brain, owing to the memories of words being threefold—auditory, visual, and kinæsthetic. *See* Aphasia.

AMŒBA COLI.—A species of amœba, found in connexion with ulceration of the colon and with tropical abscess of the liver. *See* Entozoa.

AMPHORIC.—A peculiar hollow metallic sound, elicited occasionally by percussion, but more commonly heard in auscultation. Amphoric breath-sound resembles that produced by blowing into an empty glass or metallic vessel with a narrow neck (*amphora*). *See* Physical Examination.

AMYGDALITIS (*amygdalæ*, the tonsils).—A synonym for inflammation of the tonsils. *See* Tonsils, Diseases of.

AMYLOID DISEASE (ἄμυλον, starch). The name given by Virchow to albuminoid disease, from the belief that the material characteristic of this morbid condition is of the nature of starch or cellulose. *See* Albuminoid Disease.

AMYOTROPHIC (ἀ, priv.; μῦς, a muscle; and τροφή, nutrition).—Associated with muscular wasting. *See* Spinal Cord, Diseases of.

ANÆMIA (ἀ, priv.; and αἷμα, blood).—Synon.: Spanæmia; Hydræmia; Oligæmia; Aglobulism. Fr. *Anemie*; Ger. *Anämie; Blutarmuth.*

Definition. — Deficiency of blood in quantity, either general or local; also, deficiency of the most important constituents of the blood, particularly albuminous substances and red corpuscles.

This definition is purely pathological, and the condition thus expressed presents many varieties, anæmia in the widest sense of the term including oligæmia, oligocythæmia, hydræmia, and spanæmia, as well as chlorosis (*see* Chlorosis, Hydræmia, Spanæmia, Oligocythæmia; and Blood, Morbid Conditions of). From the clinical point of view, anæmia is a condition of system in which impoverishment of the blood, whether from want or from waste, is associated with symptoms of imperfect discharge of the vital functions.

Ætiology.—The causes of anæmia are generally multiple and complex. First, the *supply* of blood to the body may be insufficient, and that from a variety of causes, of which the chief are:—derangements of alimentation, including insufficient food, constipation, and morbid states of the lymphatic and blood-glands; such defective hygienic conditions affecting the formation and nutrition of the blood as want of light, air, and muscular exercise; prolonged exposure to the influence of certain poisons, as lead, mercury, and malaria; and, lastly, interference with the free circulation of the blood by cardiac or vascular disease, such as valvular disease or dilatation of the heart and aneurysm of the aorta. Secondly, the *consumption* of blood may be increased by hæmorrhage; by profuse discharges, such as suppuration, catarrh, and albuminuria; by rapid growth and development; by frequent pregnancy and superlactation; by excessive muscular exertion; and by the presence of pyrexia, or of new growths, which rob the system of nutritive material. In a third group of cases of anæmia both the supply and the consumption are at fault. Thus derangement of the organs and of the whole process of sanguification is frequently associated with profuse discharges from various parts; and in acute febrile diseases, malignant diseases, and the 'chronic constitutional diseases,' such as syphilis, tuberculosis, Bright's disease, albuminoid disease, Addison's disease, and others, the cause of the anæmia is extremely complex. But the majority of the cases of anæmia that are regarded and treated as such, fall into the class to which the name of *idiopathic* has been applied. In such cases the anæmic condition is due, not to any disease so called, but to disturbance of nutrition generally—that is, of the healthy relation between the demands of the system and the supply of nutrient material. This condition occurs chiefly in children and young women, at the period of bodily growth and of the development and early activity of the sexual functions; and when, as so frequently and unfortunately happens, the air, light, food, occupation, and nervous relations of the individual are all more or less unhealthy.

ANATOMICAL CHARACTERS.—The blood suffers three principal changes in declared anæmia, namely: (1) deficiency in amount (oligæmia); (2) deficiency in red corpuscles or hæmoglobin (oligocythæmia, aglobulism); and (3) deficiency in albuminous constituents (hypalbuminosis). Of these oligæmia is the simplest, and perhaps never occurs alone; it is speedily complicated with aglobulism, which is a very early and common, as well as the most obstinate, change in the blood. Hypalbuminosis is the most advanced and perhaps the most serious alteration of the three (*see* BLOOD, Morbid Conditions of). The blood is scanty and pale; has a diminished specific gravity; and coagulates slowly and loosely, or in aggravated cases not at all, settling into three layers—consisting respectively of red corpuscles, white corpuscles, and plasma. The body presents certain changes directly due to the state of the blood. Whether the anæmia be local or general, the corresponding parts are blanched and 'bloodless.' The cells of the tissues become atrophied and degenerate, in consequence of, and in proportion to, the interference with their plastic and functional activity respectively; and the so-called 'anæmic' form of fatty heart, liver, kidneys, and other organs, is the result. If death occur suddenly from acute anæmia, the heart is found empty and contracted.

PATHOLOGY.—When the volume of blood in the body has been reduced by repeated small hæmorrhages, the phenomena that supervene, whilst they express the want of blood as a whole, and of its several constituents, are chiefly referable to the loss of two of these constituents—the albuminous substances and the red corpuscles or hæmoglobin, that is, of the oxidisable and the oxidising materials. The pathology of hypalbuminosis and aglobulism is fully discussed in the article on the morbid conditions of the blood, to which the reader is referred. The same effects will be produced by a drain of the liquid part only of the blood, or by poverty of the blood from any of the causes enumerated above, whether of the nature of waste or of want; inasmuch as loss of plasma speedily affects the nutrition of the red corpuscles. These phenomena constitute the symptoms of the anæmic condition whatever may be its cause; their relative prominence naturally varying according to an immense number of circumstances.

SYMPTOMS.—The subjects of anæmia are usually girls and young women. Their general appearance, which is striking, is one of pallor, debility, and variable loss of feminine fulness. The visible parts of the surface are pallid, often with a tinge of dusky brown on the eyelids and the backs of the hands; the clearness of the complexion varies with the normal pigmentation of the body; the skin is soft, satiny, and rather loose. The mucous surfaces also are blanched; the sclerotic is pearly blue. The loss of flesh may be moderate, or it may be considerable. The extremities are cold, and the legs and lower eyelids are often œdematous. Pyrexia is occasionally present, the temperature rising as high as 102° Fah. or even more. Bodily strength is reduced; muscular force is diminished, while myalgia is common; an air of languor and want of vigour pervades the whole demeanour; and the patient is sleepy, dull, and depressed. The subject of anæmia generally complains of weakness, various pains about the body and head, and marked shortness of breath on the least exertion. The last symptom is unaccompanied by other evidence of respiratory derangement; in character the breathing is regular, and short or even panting. The symptoms referable to the circulation consist chiefly of palpitation on exertion; a tendency to faint; and pain or distress over the cardiac region. The physical signs indicate cardiac enlargement of variable degree. A rough systolic murmur is usually heard over the pulmonary artery; a soft systolic murmur at the aortic base, in the mitral area, possibly over the whole præcordia, and even at the scapular apex; the second sound is often universally accentuated. Over the cervical vessels a systolic murmur is commonly audible, followed by a sharp sound; in the neck a loud venous hum. The cervical vessels may throb; the radial pulse is small, weak, and of variable but usually increased frequency and suddenness. There is a tendency to hæmorrhages, especially epistaxis; and petechiæ are occasionally observed. The digestive system is markedly affected, as shown by loss or perversion of appetite; an anæmic, often bare, but variable tongue; dyspepsia, nausea, and sickness after meals or on rising; and constipation, which is present in the majority of cases, and is frequently prolonged and severe. The menstrual functions are almost always deranged: amenorrhœa is common, in some form; menorrhagia is rare (except as a cause of anæmia); dysmenorrhœa is frequently associated; and leucorrhœa is the rule. The urine varies greatly. Headache, tinnitus aurium, and other cerebral symptoms are common. There may be swelling of the optic disc. Blood drawn from the finger presents aglobulism. *See* HÆMACYTOMETER.

COURSE AND TERMINATIONS.—The course of anæmia in this form is essentially slow and progressive, unless it is checked; the *duration* is perfectly indefinite. The course of the symptomatic form will naturally vary with its cause. Idiopathic anæmia rarely terminates fatally; and, when it does so, the event may be referred, with few exceptions, to some complication. Occasionally, however, it progresses steadily to death. *See* ANÆMIA, PERNICIOUS.

Intercurrent diseases may be expected to be severe in an anæmic condition, in proportion to its degree.

DIAGNOSIS.—Anæmia is generally recognised with the greatest ease, and the chief question of diagnosis relates to its *cause*. The first point to be determined, therefore, is whether it is not *symptomatic* of some more grave state, such as tuberculosis, syphilis, albuminoid disease, or some other of the many possible causes of poverty of blood. Having settled that the anæmia is *idiopathic*, we must next exclude two diseases with which it may be confounded, namely chlorosis and leukæmia. Chlorosis, in which the plasma is not considered to be altered, and which possesses otherwise a special pathology, is expressed by the yellow tint of skin, by the absence of wasting and of dropsy, as well as by other features (*see* CHLOROSIS). The diagnosis of pernicious anæmia is fully given in the article on that subject. Leukæmia is recognised by examination of the blood and spleen. The starting-point of the blood-change in idiopathic anæmia can only be discovered by investigation of all the facts of the case.

PROGNOSIS.—The prognosis of anæmia is favourable as regards life. In simple anæmia from loss of blood, the patient may be assured of speedy and complete recovery. In idiopathic anæmia, however, this promise can be given only when the cause can be removed or avoided. Under favourable circumstances and judicious treatment, improvement will begin almost immediately; and health should be restored after a few weeks or months.

TREATMENT.—The treatment of anæmia, when it is symptomatic of some more grave condition, such as Bright's disease or phthisis, does not require notice here. When blood has been lost in serious quantity, without other injury of consequence, it will be naturally restored if but sufficient time be given, and interference otherwise avoided. Attention to the ordinary rules of health, abundance of food and air, and moderate exercise, will surely, if slowly, restore the patient, without the administration of a single drug. Even in this case, however, treatment may be of great service, by arresting, if necessary, the cause of the anæmia, such as menorrhagia or epistaxis; and by assisting nature, if the condition should threaten at any time to become intensified by its own effects.

But before the blood can be restored in the large and ill-defined group of cases known as idiopathic anæmia, the unhealthy influences under which the patient is placed, and the functional and other derangements, which are usually accountable for the imperfect sanguification, must be discovered and corrected. Each case must be treated on its own merits, routine being avoided. Where the ætiology is complex, treatment must be equally general, and the whole system of life will have to be reformed. On the other hand, in the rapidly growing child and youth, and still more in girls at puberty, the great demand for nutritive material must be duly considered, and every obstacle to its supply removed. When other than direct discharges are draining the blood they must be checked. Lactation may have to be forbidden; and leucorrhœa and spermatorrhœa will sometimes demand local treatment.

The removal of the cause being thus made the first element in treatment, means must next be adopted for the restoration of the blood. To accomplish this, it will be necessary to bring the alimentary tract and the organs of sanguification into a healthy state. Dyspepsia and constipation require immediate treatment. The best plan is to begin with a brisk purge, and to follow this up with a course of iron and aloes (in various combinations) every night, the pill form being generally preferred, so as to secure one, and only one, daily evacuation of the bowels. Therewith a bitter and alkaline stomachic mixture may be given before meals for a few weeks. The food must be carefully ordered, so that it shall not only supply the albuminous elements that are specially deficient in the blood, but be retained, digested, and absorbed.

The process of sanguification may be successfully assisted by means of drugs. Iron is the sovereign remedy for aglobulism; and, practically speaking, it speedily becomes a question in the medicinal treatment of a case of anæmia in what form iron is to be given. The compound iron mixture of the pharmacopœia, perhaps, answers more frequently than any other; but, on the one hand, when there is constipation, as is so often the case, combinations of aloes and iron in pill, or a mixture containing the protosulphate with purgative saline sulphates, will be more suitable for a time; on the other hand, when there is a tendency to discharges, the persalts with bitters, combined, if necessary, with sulphate of magnesium, will answer the purpose better. Compounds of iron with quinine or strychnine should be given in cases where less marked anæmia occurs in older subjects, with nervous depression and general want of vigour. In special cases the ferrum redactum, saccharated carbonate, or the vinum ferri (with compound decoction of aloes in constipated subjects), ammonio-citrate of iron, or Blaud's pill may be ordered. Some patients cannot take iron except in the effervescing form; others only if it is presented to them highly diluted—for instance, as a few drops of the tincture of the perchloride in a glass of water. To meet this difficulty, as well as to secure the benefit of many other recuperative influences, a course of chalybeate waters may be the best means that can be devised (*see* MINERAL WATERS). The addition of arsenic to the iron is invaluable in many cases; in other instances arsenic alone, given as Fowler's solution, proves eminently successful after iron has failed. According to some authorities, manganese assists the action of iron. Cod-liver oil is sometimes prescribed with success. Other symptoms must be treated on ordinary principles. Uterine complaints demand special attention; and bromides, ergot, opium, and other sedatives and astringents are indicated where excitement and excessive discharge are present.

Whilst these dietetic and medicinal measures are being carried out, it is impossible to insist too strongly upon attention to bodily and mental hygiene: the use of the tepid morning bath; the proper disposal of time in relation to exercise, education, and amusement; healthy clothing, or rather 'dress'; the avoidance of unwholesome excitement; early hours, and sufficient sleep. In a large number of cases change of air fulfils many of these conditions. On the other hand, in acute anæmia, as well as in severe cases of every kind, rest in bed is imperative for a few days. Time is an essential element in the cure. A frequent change in the form of the medicinal remedies is also advisable.

J. MITCHELL BRUCE.

ANÆMIA, LYMPHATIC.—A form of anæmia which is associated with a peculiar affection of the lymphatic system. *See* LYMPHADENOMA.

ANÆMIA, PERNICIOUS.—SYNON.: Fr. *Anémie pernicieuse progressive*; Ger. *Progressive perniciöse Anämie.*

DEFINITION. — A progressive hæmolytic process affecting both sexes, especially in middle life, characterised by fatty degeneration of the heart and retinal hæmorrhages, and in nearly all cases terminating fatally.

Pernicious anæmia includes two varieties: the primary, essential, or 'idiopathic anæmia' of Addison; and the deuteropathic, symptomatic, or secondary anæmia of German authors. The clinical symptoms in the two varieties are, on the whole, alike. Whilst it is possible that pernicious anæmia is really not a disease *per se*, but a group of symptoms, yet for clinical purposes these symptoms are constant enough to constitute a distinct disease.

ÆTIOLOGY. — Pernicious anæmia occurs about equally in men and women, unless we include all cases of fatal or severe anæmia secondary to uterine hæmorrhage. In women the disease is most frequently met with between the ages of 20 and 40 (the period of child-bearing), whereas in men it occurs most frequently between 40 and 60. The youngest age on record is 7, the oldest is 68. Although the disease is more common among country people than town-dwellers, this cannot be ascribed to their respective occupations.

Among the better classes the disease is uncommon; when it does occur, no cause can be ascertained, excepting, in a few instances, mental worry, grief, or fright. It occurs with especial frequency in countries the inhabitants of which are poor and insufficiently supplied with food, particularly nitrogenous food, and who live in small, overcrowded, badly lighted, and ill-ventilated houses. On this account a great number of cases have been recorded by Swiss observers —Biermer, Quincke, and others. Repeated pregnancies, especially in women who are badly nourished or suffer from ordinary bloodlessness, are also a cause of pernicious anæmia. It seldom affects primiparæ. Excessive lactation, severe puerperal or other hæmorrhages, dyspepsia, and the uncontrollable vomiting frequently met with during pregnancy, are considered by many authors among the causes of the secondary form of this disease. Some German authorities include parasites, such as the Ankylostoma duodenale and the Bothriocephalus latus. Malaria and yellow fever have also been antecedent to this form of anæmia; and Müller has lately called attention to the connexion of constitutional syphilis with this disease.

ANATOMICAL CHARACTERS. — The appearances of the organs after death from this disease are the result of the anæmia. The skin may be pale, or presents a lemon-yellow colour. As a rule the body is not emaciated; and on section a thick layer of subcutaneous fat, of canary-yellow colour, is usually found. The muscles are of good colour. The heart and the great vessels contain but little blood, and that of a pale colour and often uncoagulated. The heart itself presents well-marked fatty degeneration, having the characteristic 'tabby cat' appearance. The fatty degeneration affects the ventricles more than the auricles, the left ventricle more than the right, and the musculi papillares more than any other part. This is the most constant of the morbid anatomical conditions. The cavities are sometimes dilated; the valves normal. Flecks of fatty degeneration are commonly seen affecting the intima of the large arteries, and the same change probably occurs in the capillary vessels, explaining perhaps the occurrence of petechiæ and retinal hæmorrhages. Small ecchymoses occur in the brain, serous membranes, and elsewhere. Passive effusions into the serous cavities are not uncommon.

All the organs of the body, with the exception of the spleen, look very pale, as if their vessels had been washed out with water. The liver is generally fatty; not much enlarged. The spleen may be normal, small, or somewhat enlarged, but never attains great dimensions, as in leukæmia. The kidneys are pale, often showing slight fatty change. The mucous membrane of the stomach and intestines often exhibits hæmorrhagic erosions; and atrophy of the tubular glands of the former has been described.

The marrow of the bones has been found normal in the majority of cases, but in some the yellow marrow has been replaced by red—probably a result of the disease rather than the cause of it. This indicates perhaps an effort on the part of this blood-elaborating tissue to take an unusually active part in the formation of red corpuscles, to compensate for their excessive disintegration.

Symptoms.—The following are the symptoms which are, as a rule, present in most of the well-marked cases of pernicious anæmia. The patient suffers from weariness, lassitude, headache, vertigo, and dizziness, with faintness, palpitation, and breathlessness on exertion. These symptoms make their approach in so slow and insidious a manner that the patient is unable to fix the date of their onset, and probably will not seek medical advice until he is incapacitated for mental or bodily work.

The aspect of the patient is characteristic: the mucous membranes are pale; the skin is usually of a light lemon-yellow colour, 'like white wax changed by age.' The conjunctivæ are white, though the presence of yellow fat beneath might lead a careless observer to believe there was slight jaundice. The patient is seldom emaciated; indeed the subcutaneous fat may be in considerable quantity. There is often slight œdema of the lower eyelids and of the feet, but these symptoms are generally late in appearing. The intellect is usually unimpaired, but answers to questions are slow, apathetic, and delivered in a low tone of voice, sometimes interrupted by long-drawn sighs. Sleep is occasionally, but not usually, heavy, insomnia being a more constant symptom. The tongue is pale, smooth, and dry; the breath offensive, with a cadaveric odour in severe cases. Stomatitis and bleeding gums are sometimes met with. In many cases dyspepsia, flatulent eructations, vomiting, and a painful sinking feeling at the epigastrium are prominent symptoms. These gastric disturbances are attributed by certain authorities to irritation of the cerebral centres by anæmia, by others to atrophy of the gastric glands. Usually there is anorexia and nausea, but some patients eat well or even to excess. Constipation or diarrhœa may occur, but usually the stools are of normal colour. Dyspnœa is sometimes the first symptom complained of. The breathing is generally accelerated, and, in advanced cases, is deep and noisy. The laboured breathing increases with the diminution of hæmoglobin, but not so rapidly as other symptoms, and is often absent as long as the patient is at rest. The action of the heart is regular and quick. Sometimes there is visible evidence of dilatation, the impulse being diffused, and the area of præcordial dulness being increased laterally. Systolic murmurs are heard over the cardiac region, sometimes loudest at the base, sometimes at the apex. A venous *bruit* in the neck is generally present. The pulse ranges between 100 and 120, and is regular, compressible, not small, often jerky, and possibly dicrotic.

One of the most striking clinical features of pernicious anæmia is the supervention of hæmorrhages. Epistaxis, menorrhagia, sometimes cerebral hæmorrhage, and towards the close of life petechial hæmorrhages and purpuric eruptions, may occur; but by far the most important are retinal hæmorrhages, because they serve as a diagnostic symptom of the greatest value.

The condition of the optic disc is shown in the accompanying figure (fig. 2). The fundus is pale, the arteries are narrow, the veins broad; the hæmorrhages are generally multiple, and flame-shaped, from their situation in the layer of nerve-fibres. They appear as linear striæ, rounded spots, or patches, clustered around the optic disc, and may have whitish or yellowish centres, due in part to leucocytes, in part to degeneration. These hæmorrhages may be quickly absorbed, often lasting only a few weeks. There may be no disturbance of vision, unless the hæmorrhage is situated in the maculæ luteæ. In all the six cases observed by the writer retinal hæmorrhages have been present.

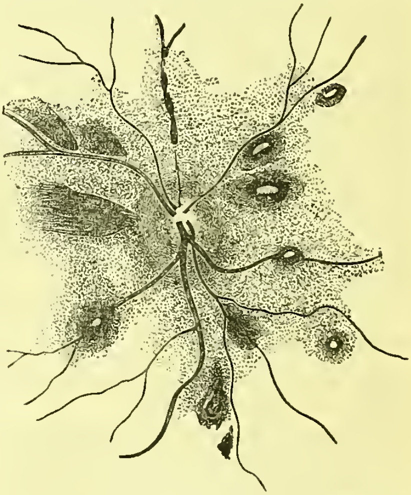

Fig. 2.—Retinal hæmorrhage. After Quincke.

More or less pyrexia is the rule in pernicious anæmia. It may be continuous for months, the evening temperature reaching 100°-101° Fah.; or it may be intermittent with sudden exacerbations. Occasionally the temperature may rise to 105° or 106° Fah. On the other hand, it may fall even as much as 10° below normal previous to death.

The state of the urine requires careful consideration. The quantity may be normal, except at the close of life, when it is often considerably diminished. It seldom contains albumin and never sugar. It is often of a deep colour, containing excess of urobilin, and there may be a direct association between the depth of colour and the hæmolytic process. In other instances, however, it is quite pale. The amount of nitrogen excreted *per diem* may be less than normal; but, as a rule, it is more than can be accounted for by the nitrogenous ingesta. Consequently it must be derived from the excessive waste of blood and tissue; but an incomplete oxidation of the nitrogenous substances leads to an excretion of urea and a deposition of fat. Uric acid often occurs in considerable quantities; indican, pathological urobilin, and pentamethylene-diamine have also been found in the urine, suggesting a morbid process in the gastro-intestinal tract. Free iron has been discovered in the urine by Dr. William Hunter.

Blood.—Notwithstanding its name, the blood in pernicious anæmia presents no changes absolutely characteristic of the disease. When drawn, it appears pale and watery, and the specific gravity is often greatly reduced. Examined microscopically, it invariably shows a considerable diminution in the number of red corpuscles, which may be reduced to 500,000 per c.mm.—$\frac{1}{10}$ of the normal or even less—in the last stages of the disease. Generally there is a striking variation in the form and size of many of the red corpuscles, as shown in the accompanying figure (fig. 3). It will be seen that some are much larger than normal (macrocytes); these are nucleated. Many, again, are pear-shaped or have an irregular contour (poikilocytes). And, finally, there are to be seen numbers of small, imperfectly developed corpuscles (microcytes). The corpuscles are usually of good colour. There is no leukæmia, but granular masses are common. Hayem holds that the presence of nucleated red corpuscles is a grave omen. There is a great diminution of hæmoglobin in the blood—sometimes in proportion to the falling-off in numbers of the corpuscles; but, owing to many of the corpuscles being more highly charged with colouring matter than normal, the hæmoglobin value of the blood may be excessive in relation to the number of the corpuscles.

The spleen and liver are in some cases enlarged, especially the former. There is also evidence of affection of another important structure connected with the elaboration of the blood—namely, the bones. These may be tender, and the sternum is especially liable to be so affected.

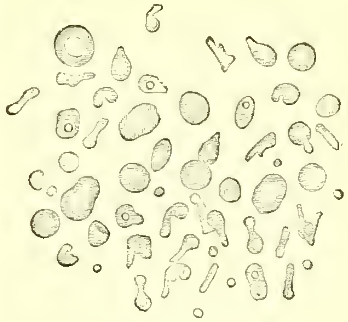

Fig. 3.—Microscopical appearances of the red blood-corpuscles in pernicious anæmia. After Quincke. Magnified 750 diameters.

Course, Duration, Terminations, and Prognosis.—Of 110 cases collected by Dr. Sidney Coupland, the total duration of the symptoms in 52 was from 1 to 6 months; in 24 from 6 to 12 months; in 25 from 1 to 2 years; in the remaining 12 cases they lasted for periods of over 2 years. Of 130 cases of primary idiopathic anæmia collected by Dr. Pye-Smith, 30 are said to have recovered. Death is usually the result simply of anæmia, and special complications are exceptienal. The prostration and weakness increase; the headache, vertigo, and vomiting become more distressing; the breathing becomes hurried, laboured, and deep ('air hunger'); the cardiac palpitation is more marked; and the patient usually falls into a deep, drowsy, lethargic state, either lying impassive, or tossing about in restless delirium, but ceasing to take interest in anything. Occasionally the patient remains conscious to the last, unable to sleep, and feeling utterly miserable and dejected, in consequence of the distressing headache and vomiting. Death may occasionally occur suddenly from syncope.

Some authors dispute the possibility of true pernicious anæmia being cured, and urge that those cases which recover cannot be considered 'pernicious.' The prognosis is always grave, if not absolutely bad; and even when a patient improves under treatment, and the condition of the blood would give hopes of a cure, a guarded opinion should always be given; for a fresh exacerbation of pyrexia, with hæmolysis, and a return of the symptoms in an aggravated form, generally occur without any apparent cause.

Pathology.—The term 'idiopathic anæmia' in our medical nomenclature is an indication that our pathological knowledge of this disease is still involved in obscurity. The examination of the blood and urine during life, taken in conjunction with changes found in certain organs and tissues after death, has thrown some light upon the disease. In health there is a constant equilibration between hæmogenesis and hæmolysis. The pigment of the urine—urobilin, and the pigment of the fæces—stercobilin, are both iron-free derivatives of hæmoglobin. It was first shown by various observers that the urine of pernicious anæmia contains an excess of *urobilin*, and the writer has been able to confirm this in two cases. Quincke has shown that there is an excess of free iron in the liver, and to a less degree in the pancreas and kidney. These organs sometimes appear slaty-black at the necropsy, from the action of sulphuretted hydrogen upon the free iron. If sections are placed in solution of ferrocyanide of potassium acidulated with hydrochloric acid, they turn blue, owing to the formation of Prussian blue. The following is an analysis made for the writer by Mr. Vasey, F.C.S., showing the amount of free iron contained in the organs.

Organ	Weight in grammes	Percentage of ferric oxide in organ	Total ferric oxide in the whole organ	Total ash in the whole organ	Percentage of ferric oxide in whole organ
Anæmic liver .	1240	·29	3·60	1·05	27·20
„ kidney	282	Traces	—	1·25	—
„ spleen	141	Traces	—	·90	—
Normal liver .	—	Traces; along with distinct traces of copper	—	1·16	—

It has been said that this is merely the iron which has been administered medicinally, but the accompanying wood-cut (fig. 4) represents a section of the liver from a patient who had not taken iron for six months.

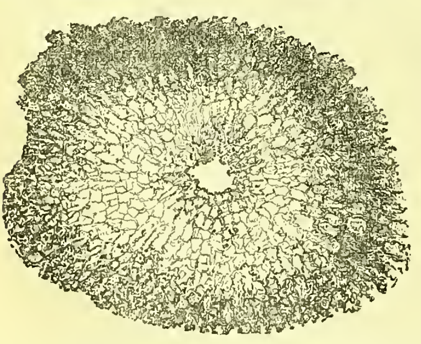

Fig. 4.—Section of the liver after treatment with ferrocyanide of potassium solution and hydrochloric acid. The dark shading indicates the deposit of iron in the portal zone. Magnified 75 diameters.

Although no specific organisms have been found in the blood or organs in this disease, yet many of the symptoms—viz. the gastro-intestinal disturbances, the peculiar cadaveric odour of the breath, the irregular attacks of pyrexia, and the presence of indican and other bodies in the urine—suggest the absorption by the portal circulation of some poison connected perhaps with the growth of micro-organisms. It has been shown that the blood in pernicious anæmia, as in many septic diseases, after being drawn, allows hæmoglobin crystals to form spontaneously. When arsenic is administered, the blood is said to lose this property, suggesting an explanation of the value of the drug in the treatment of the disease. Again, if putrid serum be added to healthy blood, crystals of hæmoglobin form. It is possible therefore that some septic poison sets up a hæmolytic process in the portal circulation, and that the hæmoglobin is broken up in the liver—into urobilin, which escapes by the urine, and free iron, which remains in the cells and capillaries of the portal zone. The urobilin, which passes from the hepatic veins into the general circulation, gives rise before its excretion to the lemon-yellow colour of the skin and fat (urobilin jaundice).

Dr. Delépine considers that the liver possesses a ferrogenic function, and suggests that in pernicious anæmia there may be an exaggeration of this physiological process. It would thus be analogous to diabetes in relation to the glycogenic function of the same organ.

It is necessary to add that some authors do not believe this to be a disease *per se*, but only a grave form of chlorosis or a pseudo-leukæmia of the myelogenic variety.

Diagnosis.—The principal diagnostic features of pernicious anæmia are the following: (1) the patient is *middle-aged*; and, except in the case of women, there is nothing to account for the onset of the disease; (2) the absence of any organic disease; (3) the severe and progressive anæmia; (4) the great diminution of the corpuscles and colouring matter of the blood; (5) alteration in the shape and size of the corpuscles; (6) signs of fatty degeneration of the heart, without arterial degeneration or valvular disease; (7) retinal hæmorrhages; (8) irregular and occasional pyrexia; (9) no emaciation, but frequently rather an excess of subcutaneous fat; (10) lemon-yellow coloured skin and high-coloured urine.

The diseases for which pernicious anæmia has been mistaken are Bright's disease, ulcerative endocarditis, tuberculosis, Addison's disease, cirrhosis of the liver, cancer of the stomach and malignant disease of other internal organs, chronic ulcer of the stomach, parasitic affections, such as ankylostoma duodenale, and pseudo-leukæmia myelogenica. It ought not to be confused with simple idiopathic anæmia or chlorosis, as it occurs at an age when these diseases are less likely to be met with.

TREATMENT.—Iron preparations are absolutely useless in pernicious anæmia, and cases have been recorded in which they have proved injurious. Dr. Byrom Bramwell introduced the employment of arsenic, and most of the recorded cases of recovery have been treated with this drug. Although it is not a specific, it does good in nearly all cases, for if it does not cure the patient it generally prolongs life. Liquor arsenicalis should be given in 3-minim doses, rapidly increased to 10 minims, three times a day; and if it cannot be tolerated, on account of gastric disturbances, it may (according to Hayem) be administered subcutaneously. Hayem also recommends the inhalation of 15 litres of oxygen a quarter of an hour before the two principal meals; and after meals a one per cent. solution of hydrochloric acid. It is necessary to give a nutritious diet, very easy of digestion, such as milk, beef-tea, eggs, scraped raw beef and meat-juice. If vomiting be very severe, nutrient enemata may be used. Transfusion has been tried in some cases, but it is doubtful whether it has ever done more than prolong life for a short time. Defibrinated human blood should be used, and not more than half a pint should be injected at once. FREDERICK W. MOTT.

ANÆSTHESIA (ἀ, priv., and αἰσθάνομαι, I feel).—Anæsthesia literally means absence or loss of sensation, which may be general or local. The word is, however, more especially employed to signify loss of tactile sensibility, as distinguished from insensibility to pain, or *analgesia*. It is further used to indicate the condition induced by the action of anæsthetics upon the system. *See* ANÆSTHETICS; and SENSATION, Disorders of.

ANÆSTHETICS.—DEFINITION.—The name given to a series of agents which are employed for the prevention of pain, but more especially applied to those used in surgical practice.

HISTORY.—The idea of annulling pain in surgical operations is a very old one. Compression of the nerves and blood-vessels, and the inhalation of the vapour of carbonic anhydride and mixtures containing it, were practised at an early date. In the sixteenth century ether was probably the active ingredient of a volatile anæsthetic described by Porta. The use of anæsthetics was, however, little understood and rarely practised. Even the suggestion of Sir Humphry Davy, that nitrous oxide should be used in minor operations not attended with loss of blood, was of little practical value, on account of the inefficient apparatus then available. In 1845 Horace Wells inhaled laughing-gas so successfully that he may be said to have introduced the practice; but he appears to have so often failed to produce the desired effect that this agent fell into disuse on the introduction of ether in 1846 by Morton, after some communications on its properties from a chemist named Jackson. In 1847 chloroform was used by Simpson, and quickly superseded ether almost all over Europe. At the present time the comparative safety of ether has caused this anæsthetic again to be preferred by many surgeons in this country.

ENUMERATION.—The three agents just mentioned—namely, nitrous oxide, ether, and chloroform—are those chiefly in use, and they have each advantages in particular cases. Experiments made with other agents, such as amylene, tetrachloride of carbon, ethidene-dichloride, and bichloride of methylene, have not shown that they possess sufficient advantages to counterbalance the defect of requiring special management in their administration. This list of anæsthetics might be still further increased, for in order to produce insensibility it is only necessary to reduce the supply of arterialised blood to the nervous centres, or to introduce into the blood a substance which deprives it of its power of oxygenating the tissues.

MODES OF USE.—Anæsthesia may be produced for surgical purposes:—(1) by benumbing the part to be operated on by means of cold; (2) by intercepting its nervous communication; (3) by arresting the activity of the nervous centres concerned in sensation. Thus anæsthetics may be *local* or *general* in their action.

Local Anæsthesia may be induced by cold. The most convenient plan is to blow a jet of anhydrous ether spray upon the part, as suggested by Dr. Richardson, and thus to freeze it. The surface to be frozen should be dry, and hence the difficulty of freezing the gum of the lower jaw, on account of the saliva. A mixture of equal parts of pounded ice and common salt contained in a bag of muslin is effective, but less easily applied. This plan is adapted for opening abscesses and boils, and for the extraction of a few teeth; but the process both of congelation and of thaw is painful. Chloroform applied locally is said to cause numbness, but it is very little used except inside the mouth, and then it owes its soothing effects to the quantity of chloroform vapour which is inhaled. Compression of nerve-trunks for inducing anæsthesia is never practised at the present day. Hydrochlorate of cocaine in a 4 per cent. solution, applied either by pipette, camel's-hair brush, or spray, is largely used in operations on the eye, naso-pharynx, and other mucous membranes. Its use hypodermically requires great caution, as its constitutional action is still imperfectly known. In neuralgia it should be applied in the vicinity of the nerve affected.

General Anæsthesia is at present rarely obtained in any other way than by inhalation, although successful attempts have been made to induce the condition by subcutaneous and intravenous injection of chloral or morphine.

Subjects for Anæsthetics.—We may say generally that any person fit for a severe operation is a fit subject for an anæsthetic; but no one is so free from danger that care in watching its effects can be dispensed with. The cases requiring the greatest vigilance are not the young and delicate, for whom a small dose suffices, but the strong, who inhale deeply and struggle much. Ether is probably better adapted than chloroform for those suspected to suffer from fatty degeneration of the heart. Many of the deaths under chloroform have occurred in intemperate drinkers, and the presence of alcohol in the system undoubtedly intensifies its effect.

Precautions.—Before commencing inhalation the following particulars should be attended to. The patient must not have recently taken a full meal; he should lie comfortably, in a horizontal position if possible, unless when gas or ether is given for a short operation; and the dress should not be tight. When the administration is begun, he should be encouraged to breathe regularly and freely. The pulse as well as the respiration must be watched. If the vapour excites either swallowing or coughing, it is more pungent than is requisite, and its strength should be diminished. Most patients are at first afraid of breathing, and some hold their breath for half a minute. The vapour should not be removed on this account, but care should be taken, by holding the inhaling apparatus farther off, to prevent the vapour becoming too strong in the interval. After volition has been abolished, any pause in the breathing should be noted, and more or less fresh air given. Further directions will be given in describing the anæsthetics specially.

Special Anæsthetics.—**Nitrous Oxide.** Protoxide of nitrogen, nitrous oxide, or laughing gas is now prepared wholesale, and sold condensed into a liquid in strong iron bottles. The gas, whether supplied thus or from a gasometer, should be inhaled from a bag having such free communication with the face that it will readily be supplied even in panting respiration. A long tube, however large, is objectionable, as the gas is less mobile than common air.

The special aim in giving gas should at first be to exclude air, and to exchange the atmosphere within the air-passages and lungs for one of pure gas. The patient should not merely be told to breathe slowly and deeply, but be shown how to do so, about fifteen times in a minute. The inspiration should not be jerking, and the expiration should be complete. It is a special merit of laughing gas that no harm can come of inhaling too freely at first. The gas-bag must be kept filled either by pressure on the gasometer, or by turning the screw tap of the gas-bottle. This may be done by the hand of an assistant, or more conveniently with the foot of the administrator. The writers' plan is to fix the bottle vertically and turn the screw by pressing the foot against an iron plate with spikes on its upper surface, and a square hole fitting the tap on its lower surface. It is imperative that the face-piece or mouth-piece *should fit accurately*, and the air-pad is almost essential to effect this in a great many cases. It should be warmed if the india-rubber is stiff. After five or six good respirations there is no need to supply fresh gas with each inspiration. The expiratory valve should be kept closed, and the inspiratory valve opened. Care must always be taken that the supply of gas is sufficient to replace any that is lost by absorption into the blood or by leakage. This is more easily effected if the gas-bag is made of thin india-rubber, so as to distend easily and contract gently with the movement of breathing. It should be sufficiently filled, so that if the mouth-piece does not fit, the gas would escape instead of air entering and becoming mixed with it.

Lividity of the skin will not help us to know when the patient is fully under the influence of the gas, neither will insensibility of the eyelids, nor yet the state of the pupils. The breathing should become stertorous or interrupted, or the pulse very feeble, or convulsive twitchings should occur, before the face-piece is removed. A little air may be admitted by raising the face-piece, if the operation is not upon the face, and by doing so every fourth or fifth respiration anæsthesia may be kept up for several minutes. The effect of a single full inspiration may be to bring the patient into a state of excitement, and the continuance of the gas *without* air brings on convulsive movements, so that it is not well adapted for any operation lasting as much as five minutes, and requiring steadiness.

Patients are sometimes so unsteady that it is found to be almost impossible to make the face-piece fit. In such cases the best plan is to cover the patient's eyes and let him breathe air, merely preventing him from rising from the chair or bed, and not speaking till he is conscious, and as soon as he becomes so to recommence the inhaling as if nothing had happened. A violent patient often becomes perfectly rational in less than two minutes.

Sickness and headache ought not to result from the inhalation of gas; but if the use of it is prolonged, or if the patient is kept for several minutes in a semi-conscious state, breathing a little air with the gas, both these symptoms may occur. The recumbent posture, quiet, and warmth to the feet, constitute all that is likely to be required in the way of treatment.

Ether.—Ether, sulphuric ether, ethylic ether, vinic ether, or oxide of ethyl, was first used for anæsthetic purposes in 1846. Before its use was well understood in England, chloroform was brought forward as a more convenient agent, and much less unpleasant to the patient. Ether is less liable to become dangerous to life, as it does not, under ordinary circumstances, depress the action of the heart. The best kind is the *Æther Purus* of the Pharmacopœia, of sp. gr. ·720.

Although it is not difficult to destroy dogs suddenly with ether, it is believed by many writers on the subject that in man it can only prove fatal by causing asphyxia, and that the signs of this condition are so easily seen and remedied that practically this anæsthetic is quite safe. The writers are not of this opinion, believing that sometimes when narcosis is far advanced, the glottis will allow ether vapour to pass of sufficient strength to stop the heart. Such cases, however, are very rare indeed. Ether is extensively administered by pouring an ounce at a time upon a very large cup-shaped sponge, which, if cold from previous use, is dipped into hot water and squeezed as dry as possible. It is to be expected that the patient will resist breathing when this is held over his face, but after a minute's struggling he becomes unconscious, and easily managed. Compared with the method of giving ether timidly, so as to let the patient remain delirious for several minutes, this may be a good plan; but there is no necessity for giving the ether so strongly if *we diminish the access of fresh air*. The administration of nitrous oxide from which air is at first excluded, and to which it is afterwards admitted very sparingly, has taught us how slight the after-effects are from the asphyxia so induced. Cones of leather or pasteboard lined with felt, and having a small opening at the apex, are better than sponges; but they should be larger. They may be made more effective and economical by placing a thin india-rubber bag over the apex of the cone, so that more of the expired atmosphere may be breathed again.

Morgan's inhaler is very efficient. The ether is poured into a tin chamber as large as a hat, containing sponge. This is covered by a sort of diaphragm, which rises and falls with respiration as the patient breathes into and out of it by means of a tube and face-piece. There are no valves. Anæsthesia results partly from asphyxia, and partly from the action of the ether. The amount breathed depends on its temperature, and on the freedom of respiration. If the respiratory movements are slight, as in young children or in persons suffering from emphysema, the amount of ether supplied is apt to be too small. Ormsby's inhaler is an improvement upon Morgan's. The sponge for ether is contained in a cage near the face-piece.

With the view of regulating the strength of the ether vapour, the late Mr. Clover contrived the following apparatus, which is made by Mayer and Meltzer. It consists of an oval india-rubber bag fifteen inches long, at the one end connected with the face-piece, at the other with the ether-vessel. Within the bag is a flexible tube also leading from the face-piece to the ether-vessel. By turning a regulator the patient is made to breathe into the bag either directly or indirectly through the tube and ether-vessel, or partly one way and partly the other. The more the regulator is turned towards the letter E, the more ether-vapour he takes. By turning it back again the amount of vapour is diminished. The ether-vessel contains a reservoir of water, which prevents the ether becoming too cold from evaporation. When in use, it may be conveniently suspended by a strap from the neck of the administrator.

At first the regulator allows the passage from the face-piece into the bag to remain open, and the bag should be filled by pressing the face-piece more firmly against the face during expiration than inspiration. By degrees the regulator is turned towards the letter E, and thus the passage to the inner tube is opened, and the air breathed through it carries ether vapour from the vessel into the distal end of the bag. When the regulator allows half the inspired air to pass through the ether, the vapour is strong enough to induce sleep in two minutes, usually without exciting cough. As the act of swallowing is excited by a smaller quantity of ether than that of coughing, it should be watched for, and the regulator very slightly turned back should it occur.

This same apparatus may be used for giving laughing-gas, all communication with the ether-vessel being cut off by turning a stopcock, and by attaching the tube leading from the gas-bottle to a mount near the bag.

By far the least unpleasant and the quickest way of preparing a patient for a surgical operation is to use gas and ether combined; the change from gas to ether being made by turning the regulator above described as soon as the patient is sufficiently under the influence of the gas to disregard the flavour of ether. The supply of gas should be stopped as soon as the ether is introduced; but if subsequently the patient is allowed to become conscious, the gas may be given freely as at first, in order to cause him to sleep again. The writers have found less sickness and more rapid recovery from the unpleasant taste of ether than when the latter is given alone. The chief difficulty is to prevent the unsteadiness of the patient, which results from the panting character of the breathing. To lessen this, the ether must be given as strong as possible without producing irritation of the throat, and the operator should wait until the influence of the ether has increased to the production of deep stertor. Air being then admitted with every fourth or fifth inspiration, the breathing soon becomes as regular as it is under ether when given in any other way.

On recovering from the inhalation of ether, patients are often in a state of intoxication for a period corresponding to the time and extent of the etherisation. The eyes should be covered, but the mouth and nose left free; and the room should be kept quiet, with a brisk fire, and the window more or less open.

Chloroform.—Chloroform was brought forward by Simpson in 1847. It should not be made from methylated spirit; and, when a drachm is poured upon blotting-paper, it should evaporate without leaving an unpleasant odour. It is the most convenient of all anæsthetics, and the most easy to administer. Unfortunately, when given beyond a certain strength, it has a tendency to produce cardiac syncope or asphyxia, and it is not improbable that some persons are particularly liable to be affected.

Some authorities think it desirable to give alcoholic stimulants before administering chloroform; others partially narcotise the patient with morphine or chloral. No doubt these agents assist the action of the chloroform, but if from any accident an excess of chloroform should be given, they interfere with the means of recovery, and for this reason are not to be recommended. There is less objection to the inhalation of a mixture of chloroform and ether, or of these agents with alcohol; but such mixtures, if kept for some length of time, alter their relative proportions, owing to the escape of the more volatile ingredients. Even the change from the administration of chloroform to that of ether, if made suddenly, is not free from danger, for, when a person is partially under the influence of chloroform, the glottis allows a high percentage of ether to pass; and, if the lung-circulation be slow, as is likely to be the case, the blood may be so highly charged with ether as to depress rather than stimulate the heart.

Chloroform, therefore, should be given gradually. The object should be to keep down the proportion of chloroform-vapour rather than to give abundance of fresh air. In preparing for an operation requiring perfect stillness, six to eight minutes should be allowed for the process. Sponges or lint saturated with chloroform, and held close to the mouth, are dangerous, from the possibility of liquid chloroform falling on the lips or into the mouth. In midwifery practice a piece of linen or blotting-paper, sprinkled with chloroform and placed at the bottom of a tumbler, is a convenient plan of administration, care being taken to prevent any liquid chloroform from settling at the bottom. In general surgery a handkerchief or towel may be folded into a small cone, open at the apex, into which not more than a drachm should be poured at first, and fifteen minims at a time afterwards. A better plan is to roll and tie a piece of lint into a compress the size of a walnut. A drachm to a drachm and a-half of chloroform should be poured upon this, which is to be held about an inch in front of the patient's upper lip, the hand and compress being covered with a towel, which should gradually be drawn over the patient's face. This plan gives considerable command over the supply of chloroform, for, when the chloroform, having cooled by evaporation, is given off too slowly, the vapour can be increased by warming the compress in the palm of the hand. When it is becoming dry it ceases to feel cold, and warning is thus given that fresh chloroform is needed. This should be supplied half a drachm at a time. In doing this the towel should still be left over the face of the patient, in order to keep him breathing a slightly chloroformed atmosphere. The movement of swallowing should be looked for, and regarded as evidence that the vapour is stronger than is necessary. If any sound like hiccough indicates laryngeal obstruction, the chloroform and towel should be removed, and, if the sound continue, the chin should be raised as much as possible from the sternum. Laryngeal obstruction arises from two main causes, viz., spasm of the glottis, and falling down of the epiglottis. The first is excited by the pungency of the vapour, and also by reflex action when certain nerves are injured, notably when a ligature is tightened upon a pile. The epiglottis covers the larynx every time we swallow, but the muscles coming from the chin raise it again directly. In deep narcosis these muscles are sluggish, and cannot act thus if the position of the chin places them at a disadvantage. If raising the chin fail to open the air-passage, the tongue must be pulled forward. In doing this the head should be kept back. Depressing the chin renders a partial obstruction complete. A laryngeal sound indicating obstruction is of little consequence if the pulse is good, since, although the breathing be imperfect, sufficient fresh air continues to be breathed; but if the pulse flags, or if it appears that the amount of chloroform in the air-passages is excessive, not a moment should be lost in seizing the tongue with forceps.

When a patient is delirious and struggling, extra care must be taken that the chloroform be not too strong, because he inhales deeply, carrying the vapour almost to the air-cells of the lungs, and, when he next closes the glottis and strains, the pressure of the air and vapour within the lungs is increased, and the chloroform enters the blood very quickly. The compress should be held at least two inches off the mouth, although the towel may still cover the face. Directly any stertorous noise is heard, a breath or two of fresh air should be allowed, and no more chloroform given till the pulse beats well and the respiration is free.

Skinner's apparatus—a cap of 'domette' flannel stretched over a frame—is a much better apparatus than a towel; but its virtue is simplicity, and it has little pretension to exactitude. Snow's apparatus is very efficient, portable, and economical. The addition of a water-jacket to equalise the temperature was a great improvement; but it should be provided with a thermometer.

The safest and least unpleasant mode of giving chloroform is by means of the apparatus fitted with a large bag of air containing not more than thirty-three minims of chloroform in a thousand inches of air. The apparatus is, however, too complex to be generally adopted. The advantage of more precise measurement of the strength of chloroform vapour than is afforded by towels or napkins will appear when we consider the several circumstances that alter it when so given.

The *strength of vapour* given off from a known quantity of chloroform is influenced by:—

1. The extent of surface of chloroform.
2. The temperature of the chloroform, which is constantly changing.
3. The temperature of the air of the room, of the patient's face, and of the administrator's hand.
4. The distance at which the chloroform is held from the patient's face.
5. The rapidity of the current of air.
6. The height of the barometer.

Moreover, when the chloroform mixture is of *known* strength, its effect is increased by high barometrical pressure; by low temperature of the blood; by deep or quick respiration, and especially by muscular efforts when the glottis is closed; and by slow movement of the blood through the lungs.

On the other hand, it is lessened by low barometrical pressure; by high temperature of blood; by superficial or slow respiration; and by rapid circulation through the lungs.

Under ordinary circumstances danger from these causes is easily averted with moderate care, for they do not often concur to produce the same effect. But if a patient, fatigued with struggling, takes a very deep breath just as fresh chloroform has been poured upon the towel, and then closes his glottis and makes another struggle—the barometer being high at the same time—it is evident that blood unduly charged with chloroform will gain access into the coronary arteries, and depress the cardiac ganglia. Death has occurred so rapidly under these circumstances, that it has been thought to be the result of shock from the operation.

Chloroform lessens, if it does not entirely prevent, the shock of an operation; but it is to be feared that, if chloroform be given freely for this purpose, a dangerous amount of it may be administered.

If a severe operation is about to be performed, the chloroform should be given in the same gradual manner as in a slighter one, but continued to the point of fixing the pupils and producing stertorous breathing; and, when the chief shock is expected, two or three breaths of pure air should be admitted, so that, if the pulse fail, there may not be an excessive amount of chloroform-vapour in the lungs.

Compounds of Chloroform.—Under this head comes *Methylene* (*Bichloride of Methylene*), which contains a variable quantity of chloroform. Its chemical characters and physiological effects are similar to those of a mixture of chloroform, ether, and alcohol. It narcotises quickly, but not safely; and, as the amount of chloroform in it is not always uniform, it is better to mix, in small quantities at a time, one part of alcohol, two of chloroform, and three of ether, and to keep the bottle so well corked that the ether is not likely to evaporate and leave chloroform in excess. The word ACE fixes the proportions in one's memory.

A mixture of one part of chloroform with four of ether is convenient for a brief operation, as this produces much less excitement than ether alone. On the whole the writers object to keeping mixtures of this kind ready-made; and it is probable that the plan of giving at the outset sufficient chloroform to abolish consciousness, and subsequently administering ether, will be found safer than mixing them together in the liquid state.

Bromide of Ethyl (C_2H_5Br).—This substance has been recommended and moderately used as an anæsthetic. Its merits are that it exhilarates and produces rapid anæsthesia. Its effects pass off quickly, without any tendency to depress the action of the heart. The objections to the use of bromide of ethyl are that it is liable to decompose, leaves a strong smell and taste of bromine, and sometimes produces headache and sickness. Two deaths from it in America have been reported. Its use has been abandoned in England.

Dichloride of Ethidene ($C_2H_4Cl_2$).—This substance is obtained by distilling aldehyde and pentachloride of phosphorus. The effects of this agent are intermediate between those of chloroform and ether. Its odour is usually preferred to that of either of the former. The writers have used it very extensively; and in minor cases, in which the operation has lasted only five minutes, the recovery is rarely attended by sickness or excitement. In the more prolonged cases it was found to cause vomiting, but this ceased much more rapidly than when chloroform had been given. Its effect upon the heart when given in large doses is depressing, and the pulse should be carefully watched during its administration.

After-treatment.—Quietude, or conversation of an encouraging or soothing character, is desirable during the half-minute of recovery from gas. The eyes should be covered, unless the view is tranquil as well as pleasant. If gas be given until there are intermissions in the breathing, or its administration continued for several minutes with a small allowance of air, there may be headache and even vomiting: still no other treatment than repose is needed.

After the inhalation of ether a taste will remain. This may be got rid of by washing out the mouth, and gargling with warm fluids; while the vapour remaining about the patient and in the room may be removed by heating the surface by means of hot bottles, and making a bright fire.

When the system has been long or profoundly under the influence of chloroform or ether, nausea and vomiting are likely to ensue. The writers have found warmth, fresh air, and abstinence from food efficient in relieving these symptoms. Hot tea and coffee, taken from a feeder without raising the head, and afterwards beef-tea and jelly, are sufficient for twenty-four hours, unless the patient wishes for something solid. The rule then should be to give little, or less than asked for. Ice relieves thirst, and serves to postpone the necessity for giving solids.

Treatment of Dangerous Symptoms.—Anæsthetics in excess destroy life by stopping the action of the heart, or the respiration; generally both are affected.[1] When laughing-gas is given to animals till the breathing has ceased, the heart continues to beat long afterwards, and artificial respiration rapidly restores them. Ether-vapour, given almost pure through a tracheal tube, will arrest the action of a dog's heart in sixteen seconds; but if it be administered as rapidly as possible with a cloth, without opening the trachea, the breathing fails before the heart, and the hæmadynamometer shows adequate pressure in the vessels whilst the breath is gasping, and for several seconds after it has ceased.

With chloroform the hæmadynamometer indicates diminished pressure directly the animal ceases to struggle, and the heart sometimes stops before the breathing. In case alarming symptoms should arise, the first effort should be directed to lessening the amount of the anæsthetic in the lungs, by pressing the trunk with both hands, and squeezing out as much air as possible without causing a shock. If, after this has been done two or three times, the air does not readily re-enter the chest, the obstruction is to be overcome either by lifting the chin or drawing out the tongue; and other artificial movements of the chest must be carried on (*see* Artificial Respiration). If pallor be noticed whilst breathing is going on, the recumbent posture and elevation of the feet are immediately required (*see* Resuscitation). Nelaton's plan of inverting the body has often been followed by recovery; but, considering the impediment to inspiration from the weight of the abdominal viscera, the writers are of opinion that the pelvis should never be many inches higher than the head. Nitrite of amyl—by reason of its effect in dilating the vessels of the skin—has been recommended, but without careful physiological inquiry, and upon very small clinical experience. Hypodermic injection of ether is also useful.

Electricity might be expected to prove the best agent to assist the action of a feeble heart. Mr. Clover's experimental observations were not favourable to its employment; and certainly artificial respiration should not be delayed one moment in order to apply electricity.

Insufflation is not to be depended on. The condition would be rendered worse by distension of the stomach, which cannot always be prevented by pressing the larynx against the spine.

Laryngotomy may be required in cases where air cannot be made to enter the chest, in spite of throwing the head backward, and removing the chin away from the sternum.

Hot-water injections may be of use, but there can be no necessity for brandy whilst artificial breathing is being carried on. Afterwards, if swallowing is difficult, brandy may be added to the enema.

Friction of the limbs in the direction of the heart is unnecessary, provided the feet are slightly raised. Where there has been great loss of blood, the limbs should be bandaged firmly, from the fingers and toes upward, as in Esmarch's plan for saving the blood of a limb about to be amputated. In warm weather, or if the body is warm, a towel dipped in cold water may be flapped against the chest, but harm would result from cooling the body generally. Bottles of hot water and hot blankets should be applied as soon as the breathing is restored, and a brisk fire should be kept up, in order to favour the ventilation of the chamber.

J. T. Clover. G. H. Bailey.

ANALGESIA (ἀ, priv.; and ἄλγος, pain).—Absence of sensibility to painful impressions. *See* Sensation, Disorders of.

ANAPHRODISIA (ἀ, priv.; and Ἀφροδίτη, Venus).—Absence of sexual appetite. Sometimes used to express impotence. *See* Impotence; and Sexual Functions in the Female, Disorders of.

ANAPHRODISIACS.—Definition.—Medicines which diminish the sexual passion.

Enumeration.—The agents employed as anaphrodisiacs are:—Ice, Cold Baths—local and general; Bromide of Potassium and Ammonium; Iodide of Potassium; Conium;

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[1] On this subject reference should be made to 'An Address on Experiments on Anæsthetics,' by Dr. Lauder Brunton, *Trans. Medical Soc. of London*, vol. xiii. p. 261, and *Brit. Med. Journ.*, 1890, ii. p. 531, for report of experiments by Dr. MacWilliam.

Camphor; Digitalis; Purgatives; Nauseants; and Bleeding.

Action.—The erection which occurs in the genital organs during functional activity is due to dilatation of the arteries in the erectile tissues, and is regulated by a nervous centre situated in the lumbar portion of the spinal cord. From this centre vaso-inhibitory nerves pass to these arteries, and cause them to dilate whenever it is called into action. It may be excited reflexly by stimulation of the sensory nerves of the genital organs and adjoining parts, or by stimuli from the alimentary canal. It may also be excited by psychical stimuli passing to it from the brain. Some anaphrodisiacs may act by lessening the excitability of the nerves of the genital organs, as the continuous application of cold, and probably, also, bromide of potassium; some by diminishing the excitability of the genital centres in the spinal cord and brain, as bromide and iodide of potassium, and conium; others by influencing the circulation, as digitalis. There are also adjuvant measures, of a hygienic and moral character, which greatly assist and may even replace anaphrodisiac medicines, such as a meagre diet, especially of a vegetable nature, the avoidance of stimulants, and the pursuit of active mental and bodily exercise. Everything tending to stimulate the genital organs, or to increase the flow of blood to them or to the lumbar portion of the spinal cord, should be avoided, such as warm and heavy clothing, or pads about the hips or loins; and a hard mattress should be used in place of a feather-bed. Everything likely to arouse the passions, such as certain novels, pictures, theatrical representations, &c., should also be shunned.

Uses.—Anaphrodisiacs are employed to lessen the sexual passions when these are abnormally excited in satyriasis, nymphomania, and allied conditions. As such excitement may sometimes depend on local irritation of the genitals, in consequence of prurigo of the external organs, excoriations of the os uteri, or balanitis; or on the presence of worms in the rectum or vagina; these sources of excitement should be looked for, and, if present, should be subjected to appropriate treatment.

T. Lauder Brunton.

ANARTHRIA (ἀν, neg.; and ἄρθρα, the limbs).—Synon.: Fr. *Anarthrie*; Ger. *Gliedlösigkeit*).—A term applied to those defects of speech (not strictly aphasic) which consist in a merely blurred, or more or less unintelligible articulation. The patient does not suffer from forgetfulness of words, but from a difficulty in their utterance. *See* Aphasia.

ANASARCA (ἀνὰ, through; and σάρξ, the flesh).—An effusion of serous fluid into the subcutaneous connective tissues, not limited to a particular locality, but becoming more or less diffused. *See* Dropsy.

ANEURYSM (ἀνευρύνω, I dilate).—Definition.—Aneurysm is a local dilatation of an artery, leading to the formation of a tumour which contains blood, and the walls of which are composed either of the tissues of the vessel, or those which form its sheath, or immediately surround it. Therefore every aneurysm, properly so called, consists of two parts—a *sac* and its *contents*.

Classification.—Aneurysms are usually divided, according to the varying composition of the sac, into the following varieties:—

1. *True* aneurysm, in which all the three coats of the artery form the sac or a portion of the sac. This variety is rare: at least it is so rarely possible to trace all the coats of the artery over any part of the sac beyond its orifice, that some pathologists deny the existence of this so-called 'true' form of aneurysm, and most admit its existence in the aorta only.

2. *False* aneurysm, in which the sac is formed by one only of the coats of the artery. This is almost always the external coat; but a sub-variety has been proved to exist as a consequence of wound of the outer part of the vessel, and is believed by some to take place spontaneously, in which the inner coat, or the inner and part of the middle coat, is dilated, pushed through the outer coat, and forms the sac. This is called *hernial false aneurysm*.

3. *Diffused* or *consecutive* aneurysm. Here the sac is formed of the sheath, cellular tissue, or other structures around the artery, which are matted together into the form of a membrane. The name 'diffused' is applied to this form of aneurysm to express the fact that the blood is at first diffused amongst the tissues, in consequence of the rupture or division, whether from injury or disease, of all the coats of the vessel, either in a part or the whole of its circumference; but it is not a good term, since, as soon as the aneurysmal sac is formed, the blood is diffused no longer, but, on the contrary, is encysted in the newly formed sac. So that the other term, 'consecutive,' seems a better one; expressing, as it does, the important fact that the formation of such aneurysms is always consecutive on a rupture, partial or entire, of the artery.

4. *Dissecting* aneurysm is seen only within the trunk of the body, and always involving the aorta—although it may spread from the main artery down to its branches. In this form the internal and middle coats have given way, or cracked; and the blood has forced its way, usually into the substance of the middle coat, sometimes perhaps between the middle and outer coats, distending the external portion of the vessel into a kind of aneurysm.

This is the nomenclature still in common use; but as the first and second varieties are practically indistinguishable during life, and the first, though called the 'true' form of aneurysm, is very rare, it would be better to include both under the common name 'true' aneurysm, and apply the term 'false' to the third or 'consecutive' form.

5. Besides these, which are all forms of pure arterial aneurysm, there are aneurysms in which the vein and artery are simultaneously involved, and which are therefore called *arterio-venous*, which will be afterwards spoken of; and tumours having a certain analogy to aneurysm, which are formed of dilated and tortuous arteries—*cirsoid* and *anastomotic* aneurysms.

Other classifications of great importance are, according to the cause of the disease, into *spontaneous* and *traumatic*; or, according to the shape of the tumour, into *fusiform* and *sacculated.* In *fusiform* aneurysm there is a dilated tract of artery, often of considerable length, from either end of which springs the vessel of its natural calibre. *Sacculated* aneurysm springs like a bud from one side of the vessel, and the artery is often buried for some distance in the wall of the aneurysm; but there are many sacculated aneurysms which approach in shape to the fusiform, the vessel being dilated for some part of its extent, so that its two openings lie at different parts, and sometimes on different aspects of the sac.

ÆTIOLOGY AND PATHOLOGY.—The proximate cause of spontaneous aneurysm appears to be usually a loss of the elasticity of the wall of the artery, whereby it loses its power of resilience after having been dilated by the force of the circulation. The loss of elasticity is commonly caused by atheroma, or else by partial calcification of the wall of the artery. In the latter case the blood often forces its way through the entire arterial wall, and an aneurysm of the consecutive variety forms,[1] or the external part of the artery is dissected off, and a dissecting aneurysm results. Inflammatory softening of the artery, without the presence of any definite atheromatous deposit, is looked upon by many writers of credit, such as Wilks and Moxon, as a common cause of aneurysm. Such low inflammation may have its origin possibly in rheumatism—and, as a matter of fact, aneurysm is often preceded by acute rheumatism; more certainly in violent strain, or in mechanical violence. Anything else which weakens the arterial wall, such as the exposure of the vessel in an abscess, is looked on as a cause of aneurysm. The yielding of a weakened arterial wall is doubtless accelerated by irregularities of the circulation. The influence of syphilis and of intemperance in causing aneurysm is widely believed, though perhaps as yet neither fact is absolutely established: the latter, at any rate, is rendered very probable from the consideration that chronic alcoholism tends to impair the nutrition of all the tissues, including the arteries, and is accompanied by a constantly irritable condition of the circulation. That syphilis may cause a fibroid degeneration of the vessels must also be allowed to be at least possible, and that it does so is the opinion of many eminent pathologists. If so, the transition to aneurysm is natural, if not inevitable. Another proved cause of aneurysm is embolism, or the obstruction of a diseased artery by a fibrinous plug, which has been known to be followed by the dilatation of the artery immediately above the plug, just as in very rare cases the ligature of a healthy vessel has given rise to the formation of aneurysm above the tied part.[1] Violence is a very frequent cause of aneurysm, even in cases which are not technically denominated 'traumatic.' The latter term is generally restricted to cases in which the vessel is wounded by a cut, or is known to be ruptured, and the aneurysm makes its appearance at once; and in these cases the aneurysm is of the 'diffused' or 'consecutive' variety. But there are, no doubt, many cases in which the artery is partially torn, and the walls, being thus weakened, afterwards slowly yield at the injured spot. This fact is illustrated by the well-known experiment of Richerand, designed to explain the frequency of popliteal aneurysm. The experiment consists in hyperextension of the knee in the dead subject. If this be carried on forcibly till the ligaments are heard to crack, it will usually be found that the two inner coats of the popliteal artery are torn.

All these causes of aneurysm act much more powerfully in later life than in childhood, and many are unknown in early years. Aneurysm, therefore, is very rare in children. In cases where the arterial system is extensively affected with atheroma, a great number of aneurysms may be found in the same person, or another may form after the cure of the first. To such cases the term 'aneurysmal diathesis' has been applied. This fact shows the great importance, in all cases of spontaneous aneurysm, of examining the whole body, to detect disease of the heart or any second aneurysm which may exist.

Almost all aneurysms contain more or less *clot*, and much of this clot is usually of the laminated variety, consisting almost entirely of fibrin mixed with more or less of the blood-corpuscles. These laminated coagula adhere very firmly to the interior of the sac; they are arranged concentrically like the coats of an onion; and usually lose their colour in proportion to their remoteness from the blood which still circulates through the sac. Their deposition depends in a great measure on the presence of rough projections from the wall or mouth of the sac, and on the shape of the aneurysm. When the latter is purely cylindrical, much less coagulum, possibly none, will be found in it. When the tumour stands well away from the artery, so that the force of the circulation is much broken, the formation of coagula is greatly favoured. The deposition of such firm coagula must be looked on as the commencement of spontaneous cure, and at any rate defends the patient from the risks of rupture, or of renewed growth of the tumour at the parts which are so lined.

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[1] Sometimes, however, the bleeding will go on without the formation of any aneurysmal sac, and lead to the loss of life or limb.

[1] For cases of this nature see *System of Surgery*, 3rd edit. vol. iii. p. 29.

SYMPTOMS.—The symptoms of arterial aneurysm are as follows:—There is a pulsating tumour, which is situated in the course of one of the arteries, and which cannot be drawn away from the vessel. The pulsation is equable and expansile, that is, it not only causes an up-and-down movement of the tumour, for such a movement may be communicated to any tumour by a large vessel lying in contact with it, but also expands the tumour laterally and in all other directions. The pulsation is in most cases accompanied by a *bruit* or blowing sound, heard on auscultation, which can be tolerably well imitated by the lips, and which is synchronous with the pulsation. Pressure on the artery above suspends both the pulsation and the bruit. Sometimes it may be noticed that the pulse below is retarded, that is, that it reaches the finger later than in the corresponding vessel on the other side. Besides these, which are the main signs of aneurysm, there are others, which are of less constant occurrence or of subordinate importance. Thus, on compression of the artery above, the tumour will empty itself more or less completely, and the greater or less change of size under these conditions is a useful test of the proportion of fluid and solid in the sac. Sometimes pressure on the artery beyond the tumour may cause an increase in its size. The pulse below the tumour is often found to differ strikingly from that on the sound side. There are many and various symptoms due to the pressure of the aneurysm on neighbouring veins, nerves, bones, and viscera—symptoms which are of subordinate importance in a diagnostic point of view in the case of external aneurysm, but are often of the greatest value in thoracic and abdominal aneurysms. Thus dyspnœa and ringing cough from pressure on the trachea, spasm or paralysis of the vocal cords from pressure on the recurrent laryngeal nerve, pain in the back from pressure on the vertebræ, or neuralgic pains from pressure on the nerves at the root of the neck, are well-known symptoms of aortic aneurysm; and, similarly, pain in the leg from pressure on the popliteal nerve, and œdema from compression of the vein, are frequent symptoms of popliteal aneurysm.

DIAGNOSIS.—The affections which are usually confounded with aneurysm are tumours of various kinds lying upon arteries, abscesses, and cancerous tumours which have large vascular spaces in their interior, and therefore pulsate. The tumours which receive pulsation from arteries against which they lie are of various kinds; cysts and enlarged glands in the popliteal space, and enlargements of the thyroid body pressing on the carotid or innominate artery, are the most familiar examples. The diagnosis is usually easy. They have commonly little or no bruit, though in some cases a dull thud is produced by their pressure on the artery; they have not the expansile pulsation of aneurysm; they present no change in size or form when the circulation is stopped; and they can usually be drawn away from the artery sufficiently far to lose their pulsation. An abscess has often been mistaken for aneurysm, but the mistake has generally proceeded from a neglect of auscultation.[1] There are a very few cases in which aneurysms have lost their pulsation in consequence of the rupture of the sac, and in which no bruit may be audible,[2] and such tumours can hardly be diagnosed from abscess except by an exploratory puncture, which under these circumstances is justifiable: these cases are, however, extremely rare. The disease most commonly mistaken for aneurysm is pulsating cancer, and the resemblance has been sometimes so striking as to deceive the best surgeons, even after the fullest possible investigation of the case. These pulsating cancers almost always grow from the bones;[3] and the neighbouring bone can generally be felt to be enlarged, which is rare in aneurysm. They have not usually the well-marked bruit of an aneurysm, nor is the bruit usually audible over the whole tumour; the pulsation also is more indistinct, and not so expansile as in aneurysm; and the growth of the tumour is more rapid.

COURSE AND TERMINATIONS.—Aneurysm is generally a fatal disease if left to itself. The sac enlarges; parts of it give way, either by a process of inflammatory softening or by rupture; or it produces fatal pressure on the surrounding parts; or the whole tumour suppurates, and the patient dies of fever, of pyæmia, or of hæmorrhage. But to this general statement, independent altogether of what the effects of any special treatment may be, there are numerous exceptions. In some cases, and especially in the fusiform kind of aneurysm, the tumour, after having attained a certain size, remains stationary, and this stationary condition is sometimes produced by a deposit of coagulum lining the sac, and leaving a canal through which the blood-stream passes, as through the normal artery.[1] In these cases, however, the symptoms persist, but there are others in which a complete spontaneous cure is obtained; and this may happen in various ways.

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[1] See a paper by the author in *St. George's Hospital Reports*, vol. vii. pp. 175 *et seq.*

[2] See a case under the care of the writer, reported in the same paper, p. 190.

[3] In one case under the care of the writer the disease was unconnected with the bones, and affected the kidney only.—*Pathological Transactions*, vol. xxiv. p. 149.

Spontaneous Cure.—The first, and probably the most usual, method of spontaneous cure is by the gradual diminution of the circulation through the tumour, and the gradual filling of the sac by successive layers of fibrinous coagulum. The second is by impaction of clot in the mouth of the aneurysm, whereby in some cases possibly the sac of the aneurysm is cut off from the blood-stream, and its contents brought to coagulate. In other cases, where more than one artery opens out of the sac, the impaction of clot in one of the distal arteries leads to consolidation of all that part of the tumour through which the circulation used to pass into the obstructed vessel, and thus a practical cure is sometimes effected,[2] *i.e.* the symptoms are cured and the disease arrested, though the whole sac is not consolidated. The third method of spontaneous cure is by inflammation of the tumour. This is usually accompanied by suppuration of the sac and evacuation of all the contents of the aneurysm, the accompanying inflammation closing the mouths of the arteries which open out of it. If the arteries are not so closed, death from hæmorrhage will occur. It seems possible that inflammation of the sac and the cellular membrane around it may sometimes produce coagulation within the aneurysm without any suppuration. A fourth way in which coagulation of an aneurysm has been known to be caused is by retardation of the circulation or impaction of clot, caused by another aneurysm above; and there is an old idea, which can hardly yet be said to be exploded, that an aneurysmal sac may by its growth compress the artery, and so lead to its own coagulation. This, however, if it ever happens, is purely exceptional.

Rupture.—The rupture of an aneurysm may take place either through the skin, in which case the hæmorrhage is usually, but not always, fatal at once;[3] or into one of the cavities of the body, when death generally occurs immediately, if the rupture is into a serous cavity, and after one or two attacks of hæmorrhage if a mucous membrane has been involved; or lastly into the cellular tissue of a part. This event is marked by the cessation of the pulsation; by sudden swelling, accompanied with ecchymosis if the blood is effused subcutaneously; and the abrupt fall of temperature below the aneurysm. A sensation of pain, or of 'something giving way,' is often experienced. Stethoscopic examination will probably detect a bruit.

TREATMENT.—*a.* MEDICAL.—The methods of treatment of aneurysm are very numerous, and it would be impossible in a summary of this kind to discuss fully all the indications for each. In the first place, those aneurysms which are inaccessible to any local treatment, or in which local treatment would involve great danger, are treated *medically*, that is by regimen, diet, and medicine, by which it is hoped that gradual coagulation will be promoted in the contents of the tumour, and thus a complete or a partial cure will be brought about, as in the natural process above spoken of. The method of Valsalva, of which the main features were starving and excessive bleeding, and which therefore produced considerable and often dangerous irregularity of the heart's action, is now given up in favour of another plan introduced by Bellingham and modified by the late Mr. Jolliffe Tufnell,[1] in which, by complete rest and restricted but nutritious diet, the absolute regularity of the heart's action is secured, and at a rate below that of health, both as to rapidity and force. Mr. Tufnell has given some interesting and conclusive examples of the complete cure of abdominal aneurysms thus accomplished, verified by dissection; and one, at least, in which an aneurysm of the arch of the aorta was in all probability entirely consolidated, though this fact was not verified by dissection. At any rate the patient was permanently restored to health. In this method of treatment drugs are only employed when necessary (as narcotics, laxatives, and tonics often are) to ensure the regularity of the functions, to control irritability, or to support the general health. The drugs which have been recommended as producing a direct effect on aneurysm by promoting the coagulation of blood in the sac, such as acetate of lead and iodide of potassium, do not, in the writer's opinion, produce any such effect, nor in fact any specific effect on the disease whatever. He has often seen a certain amount of improvement under the use of these drugs, but not, he thinks, more than the regimen and diet used at the same time would account for. Other drugs, as aconite and digitalis, are recommended in order to steady and reduce the heart's action, and the latter especially is sometimes a useful adjuvant, if employed with caution, to the treatment by restricted diet and rest. The rest is *total*, the patient never leaving his bed, nor ever rising from it or changing his position more than by occasionally turning on his side; the bowels are so regulated as to avoid both constipation and looseness; and the diet is restricted to about 10 oz. of solid food, of which one half is meat or fish, and 8 oz. of fluid (comprising 2 or 3 oz. of light wine if necessary), per diem. The period may be extended indefinitely, so long as improvement continues; but in all cases the patient and his friends should be prepared for a confinement of not less than three months. *See* ABDOMINAL ANEURYSM; and AORTA, Diseases of: *Aneurysm.*

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[1] See the representation of a case of this kind in *System of Surgery*, 3rd ed., vol. iii. p. 25.

[2] See a case of innominate aneurysm with remarks in *The Lancet*, June 15, 1872, p. 818.

[3] Instances of successful ligature of the artery above bleeding from ruptured aneurysm are on record. See a case in *The Lancet*, 1851, vol. ii. p. 30, in which the femoral artery was successfully tied after the bursting of a femoral aneurysm through the skin.

[1] *The Successful Treatment of Internal Aneurysm*, 2nd edit. 1875.

b. SURGICAL.—Most aneurysms which occupy an external position, and are therefore amenable to surgical treatment, are curable, when the degeneration of the vascular system is not too extensive, by mechanical means. Of these the chief and by far the most successful are either the *ligature of the artery,* whether in the sac, above it, or in some special cases below; or *compression,* applied either to the artery above the aneurysm, or to the tumour itself, or simultaneously in both situations, and either by the pressure of an instrument, of the fingers, or of Esmarch's bandage. But as these methods of treatment belong exclusively to the province of surgery, it is thought better in a work of this kind merely to name them, and to refer the reader to the standard works on surgery for their description.

The other methods of surgical treatment are far less successful than the above, and have the great drawback of being addressed exclusively to the contents of the sac; while in the treatment by the ligature and by compression the resilient power of the sac, and its consequent reaction on the blood which it contains, no doubt play a great part in the cure. The methods now to be mentioned, on the contrary, as far as they act on the sac at all, rather tend to contuse or to inflame it.

Galvanopuncture.—The first is galvanopuncture, in which a current of electricity of low tension, long continued, is passed through tho blood in the sac, decomposing it, and causing its coagulation. Needles are plunged into the sac, and are then connected with the battery; and the action is continued until the reduction in the pulsation and the flattening of the tumour show that the blood has been partly coagulated. Authorities differ as to the details of the method. Some apply first the positive and then the negative pole to each needle; others the negative pole only, the positive being brought in contact with the neighbouring skin; while some, on the contrary, use the positive pole only. It will be found on experiment that a certain amount of coagulation takes place around both poles, the clot round the positive pole being smaller but firmer than that round the negative. The object of the operation is to fill the sac as much as possible with coagulum, which shall gradually harden, and shall attract to itself fresh coagula. The dangers of the proceeding are those of inflammation of the sac, or of the cellular tissue around it; of suppuration within the tumour, or of sloughing of the punctures and hæmorrhage; and it must be allowed that the effects of galvanopuncture are very uncertain, both as to the amount and firmness of the coagulum produced. Still there is satisfactory evidence of benefit in many cases, and of a cure in a few. The danger of inflaming or cauterising the sac or the tissues around may be in some measure obviated by coating the needles with vulcanite, as recommended by Dr. John Duncan of Edinburgh. For a very clear exposition of the details of this method, as well as for statements regarding the success which has attended electrolysis hitherto, the reader is referred to the article on electrolysis by this authority, in Heath's *Dictionary of Practical Surgery.* The writer thinks himself justified in adding that electrolysis should be restricted to cases of thoracic, subclavian, or abdominal aneurysm, which cannot be cured by medical means, and in which rupture seems to be imminent, while the situation of the tumour forbids the application of ligature or pressure.

Coagulating injections.—Another method of producing coagulation of the blood in the sac is by the use of coagulating injections. Other fluids have been employed, but the only one in general use now is the perchloride of iron. The circulation is to be suspended by pressure on the artery above, and also, if possible, below the tumour, before the injection is made and for some time afterwards. The method is a very dangerous one for large aneurysms, on account of the risk of embolism, sloughing, and inflammation, but it may be used with success in small cirsoid and anastomotic aneurysms, and also in varicose aneurysm.

Introduction of foreign bodies.—Aneurysms have also been treated by the introduction of foreign bodies into the sac, with the view of producing coagulation of the blood upon the foreign substance, such as fine wire, carbolised catgut, and horsehair; but no case of complete cure has hitherto been reported, though in a celebrated case of aneurysm of the abdominal aorta, operated on by Signor Loreta, of Bologna, the sac was completely consolidated. This was, however, followed by the rupture of the artery just above the tumour.

Manipulation.—Finally, aneurysms may be treated by manipulation. The object of this treatment is either to detach a portion of coagulum from the wall of the aneurysm, which may be carried into the mouth of the sac or the distal artery, and so effect a cure as in our second mode of spontaneous cure, or at any rate so to disturb and break up the clot, that its detached laminæ may form nuclei for further coagulation. With this view the aneurysmal tumour is grasped between the two hands to squeeze all the fluid blood out of it, and one wall rubbed against the other till a 'friction of surfaces is felt within the flattened mass.'[1] The proceeding is obviously a very dangerous and uncertain one, but some indubitable cures have been thus effected.

Arteriovenous Aneurysms. — A few words must be added with respect to the rarer forms of aneurysm. Arteriovenous aneurysms are generally, but not always, traumatic, and are divided into two chief forms:—1. *Varicose aneurysm*, in which there is a small aneurysmal tumour communicating both with the artery and with a vein which is always varicose; and 2. *Aneurysmal varix*, in which the opening between the two vessels is direct without any tumour interposed; the vein pulsates as well as being varicose, and the temperature of the limb and nutrition of the skin and hair are increased. In all forms of arteriovenous aneurysm the artery after a time becomes thin and much dilated. The signs of arteriovenous differ from those of arterial aneurysm mainly in this—that besides the intermittent blowing murmur caused by the arterial current, there is a continuous purring or rasping bruit due to the venous current; and that besides the intermittent pulsation there is a continuous thrill. Varicose aneurysm may be cured by digital pressure applied directly to the venous orifice, and indirectly to the artery above at the same time; or the old operation may be performed, the clots being turned out of the sac and the artery tied above and below, the vein being of course laid open and secured either by ligature or pressure; or the artery may be tied above and below without opening the sac. Electropuncture and coagulating injections have also been used with success. Aneurysmal varix does not usually require or admit of surgical treatment. If it does, the ligature of both parts of the artery is the only measure that can be adopted, on the failure of compression.

Cirsoid and Anastomotic Aneurysms.—*Cirsoid aneurysm*, or *arterial varix*, is a tumour formed by the coils of a single dilated and elongated artery;[2] while *aneurysm by anastomosis* is a tumour formed by the coils of numerous dilated and elongated arteries, with the dilated capillaries and veins which communicate with those arteries. It is often difficult to distinguish these two forms of arterial disease from each other. Aneurysm by anastomosis frequently originates congenitally as one of the forms of nævus. The usual situation of these tumours is on the scalp. They have often a peculiar continuous buzzing or rushing murmur, which is propagated over the whole head, and much disturbs the patient's rest; while they are liable to ulcerate and to become the source of serious, and even fatal, hæmorrhage. Some cases of spontaneous cure are on record. Very numerous methods of treatment have been employed, of which the writer can only mention those which are most generally useful. When feasible, the total removal of the tumour with the knife is certain to effect a radical cure, but this operation is often too dangerous to be attempted. The entire removal by ligature is still more rarely practicable. The galvanic cautery is often successful: incandescent wire being drawn through the mass in various directions divides it into portions, and obliterates the vessels by producing cicatrices at the parts cauterised. Setons have also been used with success, when combined with the ligature of the trunk-artery; and the ligature of the artery alone has been said to be followed by success, but certainly is generally unsuccessful. Finally, coagulating injections and galvanopuncture have both effected a certain number of cures. T. HOLMES.

ANGEIECTASIA (ἀγγεῖον, a vessel; and ἔκτασις, extension).—Extension or hypertrophy of the capillaries and minute vessels of the surfaces of the body, especially the skin; hence *angeiectasia capillaris*, a term applicable to several forms of vascular nævus. *See* TUMOURS: *Angeioma*.

ANGEIOLEUCITIS (ἀγγεῖον, a vessel, and λευκὸς, white).—Inflammation of lymphatic vessels. *See* LYMPHATIC SYSTEM, Diseases of.

ANGINA (ἄγχω, I seize by the throat, strangle, or choke).—SYNON.: Fr. *Angine*; Ger. *die Bräune*.

The term *angina* was originally applied by Latin writers on Physic, and is still much used on the Continent, to indicate a condition in which difficulty of breathing and of swallowing exist either together or separately, caused by disease situated between the mouth and the lungs, or between the mouth and the stomach. By a special affix to the original term, significative of the seat or the nature of the disease, several morbid processes are known and described, for example:—*angina parotidea*, or mumps; *angina tonsillaris*, or quinsy; *angina laryngea*, or laryngitis; *angina pectoris*, or breast-pang; *angina maligna*, or malignant sore-throat; *angina membranosa*, or croup.

These and numerous other diseases, differing essentially in their nature and pathological relations, and having nothing in common but certain difficulties in breathing or swallowing, are thus classed under the word *angina*. Such a classification is open to several objections, and has nothing to recommend it. With the exception, therefore, of *angina pectoris*, which has a special and familiar signification, the various diseases occasionally recognised by the term angina will be found described under the names by which they are generally known in this country. *See* also CYNANCHE.

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[1] Sir W. Fergusson, *Med.-Chir. Trans.* xl. 8.

[2] See the figure on p. 93, vol. iii., of the *System of Surgery*, 3rd edition.

RICHARD QUAIN.

ANGINA PECTORIS.—SYNON.: *Syncope Anginosa; Angor Pectoris;* Suffocative Breast-pang; Fr. *Angine de poitrine;* Ger. *Brustbräune.*

DEFINITION.—A paroxysmal affection of the chest, characterised by severe pain, faintness, and anxiety; coming on more or less suddenly; essentially connected with disorders of the pneumogastric, the sympathetic, and spinal nerves, and their branches; and frequently associated with structural disease of the heart.

ÆTIOLOGY.—In searching for the *predisposing causes* of angina pectoris, we frequently notice: (1) A diseased state of the heart. (2) Morbid changes in the nerve-tissues. (3) The existence of a peculiar condition of the nervous system, which may be described as an undue susceptibility to impressions. It would seem to be often hereditary, and to be found in those temperaments in which there is a high development of the nervous element. Thus it is that this disease has caused the deaths of many who, by their intellectual development, have left their mark on the world's history. It will suffice to mention, as instances in this country, the names of Lord Clarendon, John Hunter, and Dr. Arnold. (4) The influence of *age* in relation to angina is conspicuous; the disease is rare before puberty; and, in the writer's experience, quite eighty per cent. of the cases occur after forty years of age.[1] (5) *Sex* also displays a marked influence amongst the predisposing causes of this disease. True angina pectoris is comparatively rare amongst women, a statement by the late Sir John Forbes showing that out of 49 fatal cases, only 2 occurred in females, and 4 out of 15 non-fatal cases—facts which entirely correspond with the writer's experience. In the hysterical temperament a form of spurious or false angina is not uncommon. (6) It is associated in many instances with certain habits of life, such as sedentary employments and indulgences at the table, and occasionally with those states of the system termed hysterical. (7) The peculiar *diathesis* which gives rise to neuralgia in various parts of the body, that in which lithic acid is in excess in the system, would seem to be in many cases an efficient cause of the symptoms of angina.

The *exciting causes* of the symptoms which constitute angina pectoris are: (1) Mental emotion, especially anger or nervous shock. (2) Irritation propagated to the vaso-motor centre, causing a sudden rise of arterial tension, which reacts upon the heart. Such irritation may proceed from the periphery, through the cerebral nerves, as the branches of the fifth nerve in operations on the teeth; through the brachial plexus; and through the sympathetic and pneumogastric nerves distributed to the abdominal viscera. (3) Cold applied to the surface, especially by cold winds. (4) Physical exertion, or any other agency by which the heart's action is excited and its regularity disturbed. (5) Certain toxic agents, more especially excessive tobacco-smoking, malaria, and the like. (6) Indigestion, acidity, and flatulent distension.

PATHOLOGY.—For a better comprehension of the symptoms comprised under the term angina pectoris, a description of the innervation of the heart, with the relations of its nerves to those of other organs and regions, will be found practically useful.

1. *Innervation of the Heart and its nervous relations.*—There are embedded in the heart-substance, especially towards the base of the ventricles, in the auriculo-ventricular groove, and in the auricular wall near the entrance of the great veins, minute ganglia, from which grey filaments are distributed to the muscle-tissue, whilst other fibres form a fine network beneath the endocardium. Connected with these so-called *terminal* ganglia is the cardiac plexus, and situated behind and in the concavity of the arch of the aorta, formed by the ultimate ramifications of branches from (*a*) the *pneumogastric*, and from (*b*) the *sympathetic.*

(*a*) The fibres of the *pneumogastric* come from the trunk, as well as from the superior and recurrent laryngeal branches of that nerve. Those fibres from the trunk and from the recurrent branch are of the 'small medullated or visceral' variety, retaining their white sheath as far as the terminal ganglia in the heart. They leave the medulla oblongata and spinal cord as part of the upper roots of the spinal accessory nerve, viz., those which arise with the vagus and with the first, second, and probably third cervical nerves, thus forming what Dr. Gaskell has designated the cervico-cranial outflow of visceral nerves (*Journ. of Physiology*, vol. vii.).

(*b*) The fibres of the *sympathetic* which enter the cardiac plexus are non-medullated. They are traceable thereto, with some difference in distribution on the two sides, from the superior, middle, and inferior cervical ganglia, as well as from the first thoracic ganglion of the sympathetic, and from the annulus of Vieussens, a ring of fibres which encircles the subclavian artery, and connects the two last-mentioned ganglia. These ganglia (*lateral*) are connected by communicating branches with the anterior primary branches of the corresponding spinal nerves, but those which join these ganglia with the eighth cervical and the first dorsal nerves are formed of grey fibres only. The central source of the cardiac sympathetic fibres is probably situated in the upper part of the spinal cord, from whence they pass out as fine medullated or visceral fibres in the *rami communicantes* from the second, third, fourth, and fifth thoracic spinal nerves. Thence passing upwards to the first thoracic ganglion, in the annulus of Vieussens, to the inferior and superior cervical ganglia, they lose their medulla, and issue forth as grey fibres, to form the superior, middle, and inferior sympathetic cardiac nerves, to the cardiac plexus above mentioned. Numerous communications take place between the various branches of the vagus and sympathetic in their course to the cardiac plexus.

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[1] Dr. J. W. Moore has directed attention (*Dublin Journal of Medicine*, February, 1890) to symptoms of angina pectoris in the acute infective diseases of children, which appear, he says, to arise from deficient innervation of the heart, granular or fatty degeneration of that organ, or from sudden increase of tension in the peripheral arteries.

With reference to the *functions* of the several nerve-structures just described, it is probable that the intrinsic cardiac ganglia are mainly concerned in distributing the impressions which reach them by the vagus and sympathetic nerves, and in regulating the nutrition of the muscular fibres of the heart's walls, which, according to recent researches, seem to possess from the cerebro-spinal centres independent automatic motor power.

The *efferent* impulses from the cerebrospinal centres are of two kinds. The one accelerating (katabolic), which reaches the heart by way of the sympathetic fibres from the cervical and first thoracic ganglia; the other inhibitory (anabolic), transmitted by those branches of the vagus derived from the spinal accessory which pass to the cardiac plexus from the trunk and recurrent laryngeal. It should be remembered that these accelerating impulses reach the heart by channels which correspond to those taken by the vaso-constrictor nerves of the body, that is from the spinal cord by the *rami viscerales* of the upper thoracic spinal nerves. The inhibitory stimuli to the heart, on the other hand, are carried by the like branches of the cervical region through the spinal accessory.

The various *afferent* impressions, which probably originate at the endocardial surface, travel to the nerve-centres mainly, if not entirely, by the branches of the pneumogastric. Those special centripetal impulses, which by inhibiting the vaso-motor centre in the medulla oblongata, cause paralysis of the vessels of the splanchnic area, are known as 'depressor,' and reach the centre by those branches which join the cardiac plexus from the superior laryngeal and cervical cardiac nerves. There is reason to believe that painful impressions also take this course.

Lastly, the connexions of this nervous apparatus with other organs and regions must be briefly mentioned, as the paths by which cardiac disturbance may be induced. These connexions are numerous and extensive. Directly or indirectly, most of the cranial nerves communicate with the vagus and sympathetic, such as the trifacial, and, more remotely, the *motores oculi*; the facial, both with the sympathetic and posterior auricular branch of the vagus; the glosso-pharyngeal, with filaments from the superior cervical ganglion, as well as with the ganglion of the root and posterior auricular branch of the vagus; the spinal accessory, with a communicating strand from the ganglion of the root of the vagus, and by incorporation in the pneumogastric of the entire internal branch; the hypoglossal, with branches from the superior cervical ganglion and ganglion of the root of the vagus; and lastly the cervical and brachial plexuses. In this way the greater part of the head and neck, the arms, diaphragm, and chest-walls, are brought into indirect nerve-relationship with the heart. The intimate association of the pneumogastric and sympathetic in their distribution to the pharynx, larynx, and lungs, to the gullet, stomach, and intestines, as well as the liver and other abdominal viscera, accounts for irritation in these organs reflexly affecting the heart's action. That certain emotional states influence the heart is well known, though the paths taken cannot be clearly defined.

Seeing thus how widespread are the relations existing in these various systems of nerves, and seeing how complicated are the causes which may, directly or indirectly, disturb their functions, and with them the functions of the heart itself—we can recognise the difficulty of identifying and establishing the pathology of the class of cases known as 'angina pectoris.'

2. *Anatomical Characters.*—Vascular and inflammatory changes in *the nerves*, such as occur in the gouty diathesis, new growths affecting the nerve-tissues, and atheromatous patches on the cardiac vessels, involving the fibres and ganglia of the cardiac plexus, and the vagus and sympathetic, have been observed and described in cases of angina pectoris.

With reference to the condition of *the heart*, angina may exist and lead to a fatal result without any discoverable disease in this organ or in its appendages. On the other hand, in the great majority of cases various forms of structural disease of the heart and aorta have been observed—such as atheromatous or calcareous degeneration at the orifices of or in the coronary arteries, in the valves, or in the aorta; dilatation of the cavities of the heart, or of the aorta; fibroid degeneration of the heart's walls, and accumulation of fat in their texture; and lastly, and probably the most important change of all, fatty degeneration of the muscular tissue, the nature of which was first described by the present writer. This lesion is constantly associated with the calcareous and atheromatous states just mentioned, and which, being more prominent, alone attracted the notice of former observers. Nay more, this lesion of the walls of the heart is in itself a frequent and sufficient cause of one of the most prominent symptoms of angina pectoris—fainting. This condition has been elsewhere described by the writer (*Medical and Chirurgical Society's Transactions*, vol. xxxiii.), under the name of *Syncope lethalis*, or fatal-faintness—a designation analogous to that given by Parry to angina pectoris, which he called *Syncope anginosa.*

The cavities of the heart have been found dilated and containing blood; or contracted and empty.

Intimately associated with the state of the heart just described are some interesting observations by Professor MacWilliam of Aberdeen, as to that condition of the cardiac muscle which is known as 'delirium cordis or fibrillar contraction.' This consists in a rhythmic, inco-ordinate, and rapidly repeated contraction of the various muscular bundles, whereby, the usual beat being abolished, the ventricles are thrown into a tumultuous state of quick, irregular, twitching action, with at the same time a great fall in blood-pressure. Such action is quite incompetent to empty the ventricle, which becomes distended with blood, and remains in a condition of diastole. This state appears to be induced by very trifling causes, frequently not recognisable. Such mechanical disturbance as the presence of a flatulent stomach or over-distended colon would certainly appear a sufficient cause, and this is a common association of an attack of angina or fatal syncope. It is probable that recovery from this condition, possible in experiments on lower animals, is impossible in man. The susceptibility of the muscle to assume this state is doubtless due to some malnutrition of a degenerative character.

3. *Summary.*— To summarise the preceding statements, it may be said that whilst there is often in angina pectoris an absence of any tangible or evident structural disease, the morbid state producing the anginous symptoms may be situated in the medulla oblongata; in the course of the nerves, or in their branches; or in the cardiac ganglia themselves. It may be the result of congestion or inflammation of the nerves, such as occurs in the lithic acid or gouty diathesis; or of other textural changes, such as connective-tissue growth or other growths involving the nerve-fibres and ganglia. An attack may be produced by emotions acting centrifugally; or by irritation acting centripetally, reflected, as just said, through the vaso-motor centre, from impressions made on the peripheral extremities of nerves. Thus acidity of the stomach, the result of indigestion, often gives rise to symptoms which very closely resemble, if they do not constitute, an attack of angina. It is by a similar mechanism that anginal symptoms have been produced by irritation reflected from the fifth nerve, as in pivoting teeth; by such irritation of the surface of the skin as results from severe herpes; by cold, or by exposure to wind. But the most frequent source of the symptoms of true angina is to be found in those structural affections of the heart already described.

Symptoms.—An attack of angina pectoris commences suddenly with pain in the region of the heart, generally on a level with the lower end of the sternum; occasionally it may be traced from a remote point, following the course of the nerves, even from the ends of the fingers. The pain is severe, and of an oppressive, grasping, crushing, or stabbing character. It extends sometimes across the chest, but more frequently backwards to the scapula, and upwards to the left shoulder and arm. The pain is accompanied by a distressing sense of sinking, of faintness, which causes the patient to seek support, or of impending death. The action of the heart is generally irregular. The pulse at the wrist corresponds; but in many well-marked cases of angina it is tense and resisting, yielding a sphygmographic tracing indicative of extremely high tension, more especially in the early stage of the attack. A fear of aggravating the pain prevents the patient from breathing deeply, though the respiratory function may not be really interfered with. The expression is anxious, the face is pallid, the lips are more or less livid. The whole surface of the body is pale, cold, and covered with a clammy sweat. Flatulence is often present; urine in some cases is passed at short intervals, and generally in abundance.

The attack, more or less severe, having lasted a variable time—from a few minutes to one or two hours—comes to an end, either suddenly or by degrees. The pallor and coldness of the surface are replaced by a uniform glow—the face may even flush; the pulse becomes soft and full; and there is a general feeling of relief. A sense of numbness or tingling occasionally remains along the course of the nerves derived from the brachial and cervical plexuses of the affected side.

Clinical Varieties.—All the phenomena of an anginal seizure as above described may be more or less modified. The attack may come on when the patient is at rest, and occasionally it sets in during sleep; but it is more commonly induced by emotion or by physical exertion, especially by walking up an ascent or by exposure to cold air or wind. The pain may be comparatively slight, and as such may recur with interruptions, it may be, during months or even years, representing anginoid symptoms rather than true angina pectoris. On the other hand it may be so severe as to mark a first, a single, and a fatal attack.

The pain may be almost limited to the region of the heart, or the lower part of the sternum; it may extend all over the chest to both arms, or spread to the sides of the head and neck and down one or both legs; and it may, in some cases, involve the diaphragm. The action of the heart may be slow, weak, and fluttering; or excited and bounding—causing a distressing sense of palpitation; it may be regular or irregular. Obstruction to the circulation from spasm of the arterioles is amongst the most constant phenomena of the seizure. The breathing sometimes assumes an asthmatic character, with comparatively little pain. There may be laryngeal spasm. The mental functions are generally undisturbed; but there is sometimes slight wandering as the attack passes off, and unconsciousness is said to be occasionally observed. The sense of danger of impending death is a characteristic symptom of angina, and one not often absent; whilst a sensation of gasping or choking, with difficulty in swallowing, is occasionally present. The position of the patient varies. Sometimes he stands, resting his arms on any convenient object; sometimes he stoops or leans forward, unwilling to be disturbed, even to speak. As a rule the attack passes off abruptly, as it commenced, leaving the sufferer free from discomfort; in other cases its disappearance is slow. The varieties in the symptoms of angina pectoris, thus seen to be remarkably numerous, characterise a form of disease which may be comparatively mild and of long duration, or one of intense suffering, hastening to a fatal termination.[1]

COMPLICATIONS. — Amongst the diseased conditions with which angina pectoris may be said to be associated, rather than complicated, are disorders of the liver and of the digestive organs, gout, renal disease, diabetes, and certain affections of the nervous system. Indeed, so marked is the latter connexion, that Trousseau dwelt on the relation which he believed to exist between epilepsy and angina—a relation which seems to depend on that susceptibility to nervous maladies already noticed as presented by some individuals, rather than on any special pathological connexion between these two diseases. More than one striking instance of this apparent connexion has fallen under the writer's notice. A marked example might be mentioned in which this susceptibility was such, that an oppressive meal of indigestible food brought on a first and distressing anginal seizure, which was followed by other attacks. Brain disease with epileptic symptoms was subsequently developed.

PROGRESS, DURATION, AND TERMINATIONS.—The progress and duration of angina pectoris will depend wholly upon the nature of its cause. Many cases in which a first attack proved fatal have been recorded. In four such cases which have come under the writer's observation, a post-mortem examination revealed the fact that there was in each slight partial hæmorrhage into the walls of the heart, which had been the seat of fatty degeneration, connected with calcification of the coronary arteries. The symptoms in these cases were those of the most severe form of angina pectoris. On the other hand, cases present themselves in which symptoms may occur at intervals for years. Thus in many instances individuals present all the symptoms of marked angina, accompanied by most of its distressing phenomena, and by the anxieties and fears that they beget; yet these cases, having more a neurotic or gouty origin, are controlled by treatment, the sufferers being restored to health, or continuing for years to enjoy comparative comfort. On the other hand, in the cases in which angina is connected with structural disease of the heart or of the nerves controlling cardiac action, the attacks progress in frequency and severity, and tend, with more or less certainty, to a fatal termination—it may be within a few days or weeks.

DIAGNOSIS.—A typical case of angina pectoris, such as has been already described, can hardly be mistaken. But when the several symptoms constituting an attack are variously modified, some being lessened in severity and others exaggerated; or when these symptoms depend on, so to speak, remote and removable causes; it is often difficult to say how far the disease is what may be regarded as a remediable neuralgia, or an attack of what is commonly recognised as true angina pectoris. So also it may be difficult to say, in cases of true angina, whether the seizure is dependent on structural lesions which admit of no improvement, or on some condition that may be amenable to treatment. But it is with this affection, as with so many others, more difficult to determine the nature of the cause on which the symptoms depend, than merely to recognise the presence of the disease itself. With reference to the diagnosis of the structural diseases of the heart above referred to, it is unnecessary to describe here that which will be found fully treated of under special heads. It remains but to say that in every case the closest scrutiny must be made into the condition of the heart and great blood-vessels, with a view to determine the presence or absence of disease. The investigation must further extend to other viscera, such as the liver and stomach, and to the digestive organs generally, as well as to the several other sources from which symptoms of angina may be excited by the reflected irritation already described. Certain symptoms resulting from the presence of other diseases should not be confounded with angina —such, for example, as the pain and dyspnœa caused by pressure of aneurysms or of tumours within the chest; by rheumatic or gouty neuralgia of the chest-walls; by pleurodynia, or acute pleurisy; or by indigestion, acidity, and flatulence. Each and all of these several conditions must be considered by way of exclusion in determining the nature and origin of the disease.

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[1] There may be mentioned here a case of a gentleman accustomed to pass lithic acid, who, for several years liable to pains over the right side of the chest as low as the hypochondrium, was seized at night with a severe aggravation of these pains, with coldness of the surface, irregular action of the heart, depression, and other symptoms, which, had the attack commenced on the left side of the chest, would have been recognised as typical angina pectoris. Similar attacks recurred at intervals for some weeks; they were easily brought on even by walking on a level surface for a few hundred yards. The most careful examination failed to elicit any evidence of organic disease in the organs of circulation or respiration. The patient is now alive after several years and in fair health. Similar cases have since fallen under the writer's notice. An interesting case has been recorded by Dr. Alexander Morison (*Edin. Med. Journal*, February 1879), in which disease of the right side of the heart was accompanied by symptoms of angina affecting the corresponding side of the chest and arm.

PROGNOSIS.—In anticipating the future of an attack of angina pectoris, we must be guided chiefly by a knowledge of its cause; in some respects also by its severity; and by the previous history of the case. Thus, if we can ascertain that the attack has been brought on by some clearly established and removable cause, such as fatigue, a chill, or indigestion, a favourable prognosis may be fairly entertained. On the other hand, if the history of the case tells that there have been several previous attacks, each increasing in severity and connected with heart-disease, we can scarcely avoid being led to the conclusion that the complaint will tend, with more or less rapidity, to a fatal termination. Between these two classes of cases there exist a large majority of instances in which the symptoms of angina, of greater or less severity, depend on neurosis, on gouty diathesis, or on other sources of nerve-disorder, amenable to treatment; and in which, therefore, a favourable prognosis may to some extent be given. But in all cases great caution should be exercised; for many instances occur in which, from slight and obscure beginnings, severe and even fatal examples of the disease have been developed.

TREATMENT.—The treatment of angina pectoris must, first, have reference to relief of the attack itself; and, secondly, during the interval, to the removal, if practicable, of the causes on which the attacks may depend.

During the attack, it is necessary first, if possible, to lessen the patient's anxiety and fear. He should be allowed to retain the position in which he feels most comfort, and an attempt must immediately be made to relieve the suffering. If the exciting cause be one that can be removed, this should be accomplished. For example, if the stomach be full of undigested food, an emetic of mustard might be given with advantage; or if flatulence be present, peppermint, ether, and other antispasmodics will be useful. If cold have produced the seizure, the feet and hands should be immersed in hot water, hot bottles applied to the surface of the body, and poultices of linseed or mustard, or embrocations of chloroform or laudanum, should be applied to the chest. For the more immediate relief of pain some of the agents now known to be effectual for the purpose should be administered. The nitrite of amyl, originally introduced by Dr. Lauder Brunton, has been found a more efficient remedy than any other hitherto recommended for the direct relief of the distressing symptoms of the disease. Five or six minims of this drug, which is usually dispensed in capsules, should be carefully inhaled from a handkerchief or piece of lint, and, if necessary, the inhalation may be repeated.

Nitroglycerine, suggested by Dr. Murrell, seems also to act efficiently in doses of $\frac{1}{100}$ grain, in the form of the official tabellæ or 1 per cent. alcoholic solution. The dose may be repeated three or four times at short intervals; but these drugs must be used with caution, as in many cases they produce headache and superficial congestion.

The action of these agents depends on the power they possess of relaxing the arterioles, thus diminishing the peripheral resistance, freeing the heart's action, and readjusting the circulation. If the pain be of a more persistent character, hypodermic injection of morphine may be used with advantage.

In those cases in which debility and exhaustion exist, the ordinary stimulants will be required, and various antispasmodics, such as ether, ammonia, &c., may be given with more or less benefit. In cases of sudden cardiac failure Professor MacWilliam recommends faradic excitation of the heart, in the form of a series of periodic single induction shocks, at the normal rate approximately of cardiac action. These should be sent through the heart so as to affect the auricles as well as the ventricles, one electrode being applied over the seat of the cardiac impulse, the other over the fourth dorsal vertebra. Large sponge-electrodes should be used, they and the skin being well moistened with salt solution. The shocks employed should be strong—sufficient to excite powerful contraction in the voluntary muscles.

During the intervals.—It is of course desirable to avoid all causes likely to bring on an attack of angina, such as mental excitement, bodily exertion, exposure to cold, and indulgence in indigestible food or heavy meals. The leading principle in treatment should, however, be to endeavour to determine and to remove, when possible, the cause of the attacks. Whether they depend on organic disease of the heart, whether on simple neuralgia, whether on gout or dyspepsia, whether on debility, or on fulness of habit—to each of such conditions must appropriate treatment, as described in other parts of this work, be persistently directed. A variety of specific remedies has been recommended, such as iodide of potassium or sodium in diseased states of the arteries, arsenic, phosphorus, iron, zinc, and the different sedatives and antispasmodics. Galvanism, in the form of the continuous current from thirty cells, has proved of use in some uncomplicated cases, the positive pole being placed on the sternum, and the negative on the lower cervical vertebræ. Huchard, in his exhaustive work on angina pectoris, discusses the action of antipyrin and phenacetin, which he regards as useful in false angina. He describes as useless, or even dangerous, the employment of chloral, sulphonal, atropine, and certain other drugs. Excellent, however, as many of the remedies above named may be under special and suitable circumstances, the result of treatment must entirely depend on the cause of the disease, and how far it is within reach of well-directed agencies. Some cases of apparently severe angina will be found to yield to treatment; whilst, as might be expected from the nature of the complaint, others unhappily proceed to a fatal termination in spite of every effort directed to their relief. RICHARD QUAIN.

ANHIDROSIS (ἀ, priv.; and ἱδρώς, sweat).—Absence or want of perspiration. *See* PERSPIRATION, Disorders of.

ANHIDROTICS (ἀ, priv.; and ἱδρώς, sweat).—Agents which check perspiration. *See* PERSPIRATION, Disorders of.

ANILINE POISON.—The aniline dyes, which are a modern discovery, present the most brilliant hues of yellow, blue, and red; as such they have been used for dyeing stockings, gloves, &c. These articles when worn are apt to produce an intense form of inflammation and vesication of the skin, which is rebellious against treatment, and liable to relapse for many months after the original attack has subsided. *See* DERMATITIS.

ANIMAL POISONS.—*See* POISONS.

ANKYLOSIS (ἀγκύλος, crooked).—Marked stiffness or absolute fixation of a joint. Ankylosis may be fibrous, bony, or vital. Ankylosis is said to be 'vital' when it is due to the impairment of motility caused by rigidity of the muscular apparatus surrounding the joint. *See* JOINTS, Diseases of.

ANKYLOSTOMA (ἀγκύλος, crooked; and στόμα, a mouth).—A genus of nematoid worms. *See* ENTOZOA.

ANODYNES (ἀ, priv.; and ὀδύνη, pain).—DEFINITION.—Medicines which relieve pain by lessening the excitability of nerves or nerve-centres.

ENUMERATION.—Anodyne medicines include Opium and its alkaloids—Morphine and Codeine; Antipyrin, Antifebrin, Phenacetin, and Exalgin; Bromide of Potassium; Cannabis Indica; Belladonna and its alkaloid—Atropine; Hyoscyamus and Hyoscyamine; Stramonium; Cocaine; Aconite and Aconitine; Veratrum and Veratrine; Conium and Conïne; Lupulus and Lupulin; Gelsemium: Chloroform, Ether, and their allies; Chloral Hydrate; Butyl-chloral Hydrate; and Camphor.

ACTION.—Pain is due to a violent stimulation of a sensory nerve being conveyed to some of the encephalic nerve-centres (probably the cerebral hemispheres), and perceived there. The impression produced on all sensory nerves, except the cephalic nerves, is conveyed, for a part of its course, to the head along the spinal cord. The primary impression which is felt as pain, is usually made upon the peripheral ends of the sensory nerves; but it may also be made upon their trunks, upon the spinal cord, or possibly upon the encephalic centres directly, without any affection of the nerves themselves, as, for example, in hysteria. Pain may therefore be relieved, while the source of irritation still remains, by lessening the excitability of the ends of the sensory nerves which receive the painful impression; of their trunks; of the spinal cord along which the impression travels; or of the encephalic centre in which it is perceived. Opium acts by lessening the excitability of the sensory nerves, the spinal cord, and the encephalic ganglia. Bromide of potassium is also believed to act on all three, although to a much less degree than opium. Antipyrin and its allies probably affect the conduction of painful stimuli through the spinal cord or sensory tracts in the brain. Belladonna and atropine affect the sensory nerves, as probably does hyoscyamus. Stramonium, aconite and aconitine, veratrine, chloral and butyl-chloral, lupulus and lupulin, and gelsemium probably act on the encephalic centres.

USES.—As opium and morphine act upon all the nervous structures concerned in the production of pain, they may be used to relieve pain whatever its cause. Cannabis indica and bromide of potassium may be employed under the same circumstances as opium, but they have very much less power. Antipyrin, antifebrin, phenacetin, and exalgin are powerful analgesics, and relieve pain without disturbing the brain. They are very useful in neuralgic pains, in headaches, and in pain depending on some affections of the spinal cord—for instance, to relieve the lightning pains in locomotor ataxy. Chloral seems to relieve pain only by inducing sleep, and does not produce an anæsthetic effect unless it is given in dangerous doses. Butyl-chloral also induces sleep, but seems to have a special sedative action on the fifth nerve; as likewise has gelsemium —and hence both these agents are used in the treatment of facial neuralgia. As the action of belladonna is exerted chiefly on the peripheral ends of the sensory nerves, this remedy is usually applied directly to the painful part in the form of plaster, liniment, or ointment. Aconite, veratrine, cocaine, and opium are also used as local applications in several forms, for the relief of pain. The various anodynes may be administered not only by the mouth, but by other channels, such as by inhalation, by enema or suppository, by hypodermic injection, or by endermic application.

Several therapeutic measures are employed as local anodynes, such as the application of dry or moist heat; cold; electricity; various forms of counter-irritation; acupuncture; and the abstraction of blood.

T. Lauder Brunton.

ANOREXIA (ἀ, priv.; and ὄρεξις, appetite).—Want or deficiency of appetite, not accompanied with disgust for food. *See* Appetite, Morbid Conditions of.

ANOSMIA (ἀ, priv.; and ὀσμὴ, smell).—Loss of the sense of smell. *See* Smell, Disorders of.

ANTACIDS.—Definition.—Medicines used to counteract acidity of the secretions.

Enumeration.—The antacids include Potash, Soda, Lithia, Ammonia, Lime, Magnesia, and their Carbonates; as well as the salts which the alkalis form with vegetable acids, such as Acetates, Citrates, and Tartrates.

Action.—Antacids are divided into: (1) those which act *directly*, lessening acidity in the stomach; and (2) those which act *remotely*, diminishing acidity of the urine. The alkalis and alkaline earths and their carbonates, with the exception of ammonia, have both a direct and remote influence; for when swallowed they act on the stomach, and being absorbed from the intestinal canal, they are excreted by the kidneys, thus lessening the acidity of the urine. Ammonia and its carbonate are direct but not remote antacids; for, although they neutralise acidity in the stomach, they are partly excreted in the form of urea, and do not diminish the acidity of the urine. The acetates, citrates, and tartrates of the alkalis and alkaline earths, on the other hand, are remote but not direct antacids. They have no antacid effect in the stomach, but undergo combustion in the blood, being converted into carbonates, in which form they are excreted in the urine, and diminish its acidity.

Uses.—Excessive acidity of the contents of the stomach gives rise to acid eructations and heartburn. It may sometimes depend on the secretion of a too acid juice by the stomach, but is generally caused by the formation of acid from the decomposition of food when the process of digestion is slow and imperfect. Antacids are given after meals to lessen acidity in the stomach, and afford immediate relief to its attendant symptoms. They may prove even more efficacious by preventing acidity when given before meals (*see* Alkalis). If the action of the bowels be regular, soda is preferable; but lime should be used if they are relaxed, and magnesia if there is a tendency to constipation. Remote antacids are given to lessen the acidity and irritating qualities of the urine in cystitis and gonorrhœa; and to prevent the deposition of uric acid gravel or calculus in gouty persons. For this purpose potash and lithia are preferable, as their urates are more soluble than those of the other bases.

T. Lauder Brunton.

ANTAGONISM.—This term is employed to express the fact that the physiological action of certain substances may be affected, even to the extent of neutralisation, by the presence in the body, at the same time, of other substances having an action of an opposite character. It is important to distinguish between *antidotal action* and *physiological antagonism*. By an *antidote* is meant a substance which so affects the chemical or physical characters of a poison, as to prevent its having any injurious action on living animal tissues. Thus acids and alkalis neutralise each other, so as to form innocuous salts; tannin may render tartar-emetic and many vegetable alkaloids insoluble; and the hydrated sesquioxide of iron may be used to precipitate arsenious acid. In these cases, the action is limited chiefly to the alimentary canal; and the object of administering the antidote is to form insoluble salts, or compounds which will be physiologically inert. But the *physiological antagonism* of certain substances is presumed to take place in the blood or in the tissues. When such a substance as strychnine, for example, is introduced into the alimentary canal, it is quickly absorbed, and carried by the blood throughout the body. It does not, so far as observation has discovered, influence all the tissues; but it so affects the spinal cord, and possibly the brain, as to give rise to severe tetanic convulsions, chiefly of a reflex character. This effect is, no doubt, due either to some interference in the nutritional changes between the blood and the tissues composing the nerve-centres, or to some specific action of the poison on the nerve-centres themselves (*see* Affinity). These changes, which are termed physiological, and on which the normal action of the nerve-centres depends, are probably of a molecular or chemical nature; and it is possible to conceive that they may be modified in different ways by different substances. Thus has arisen the idea of physiological antagonism; and experiment has shown that, within certain limits, which will no doubt vary in each case, such an antagonism is possible. Antagonism may be either local, affecting one organ, as is seen in the opposite effects upon the pupil of opium or morphine upon the one hand, and stramonium, hyoscyamus, or belladonna upon the other; or it may extend apparently to more important organs or groups of organs, as in the case of the antagonism between strychnine and the hydrate of chloral. The most important investigations upon the subject of physiological antagonism are the following:—

(1) *Physostigmine* and *Atropine*, by Professor Fraser—an inquiry which showed that the fatal effect of three and a half times the minimum fatal dose of physostigmine may be prevented by atropine. (2) *Atropine* and *Prussic Acid*, a research by Preyer of Jena—of a more doubtful character as regards the point to be proved, but still sufficient to show that, within certain limits not yet indicated, it is possible to prevent the fatal action of prussic acid by atropine. (3) *Atropine* and *Muscarine* (the active principle of *Agaricus muscarius*)—which were found by Schmiedeberg and Koppe to have entirely antagonistic actions on the ganglia of the heart—muscarine exciting the intracardiac inhibitory centres, and stopping the heart in diastole, while atropine has the contrary effect. (4) *Chloral* and *Strychnine*—an antagonism first pointed out by Oscar Liebreich, who showed that minute doses of strychnine might so rouse an animal from the effects of an overdose of chloral as even to save its life. And (5) *Strychnine* and *Chloral*—with respect to which Hughes Bennett demonstrated the converse of the last-mentioned observation, namely, that in the rabbit a fatal dose of strychnine might be so antagonised by a dose of chloral as to save life. Other examples of antagonism are: chloroform and amyl-nitrite, cocaine and morphine, atropine and jaborandi, strychnine and hydrocyanic acid, thebaine and chloral, and digitalin and aconitine.

Conclusions.—It has unfortunately to be admitted that the practical results of the preceding researches have not been very encouraging. In all of these investigations it was quite apparent that the limits of physiological antagonism were very narrow. Three elements affect the chances of success in the way of saving life:—(1) the age and strength of the animal; (2) the amount of the doses of the two active substances—so that if either the one or the other active substance be given slightly in excess, death will probably take place; and (3) the time between the administration of the two active substances. If the stronger be introduced first, and be allowed to manifest distinctly its physiological action, it is almost impossible to counteract this by that of another substance; but if the two substances be introduced simultaneously, or if the supposed antagonist to the more active substance be introduced first, the chances of success are much greater. It is apparent, therefore, that the facts relating to physiological antagonism at present known in science do not hold out much hope of good results from their application in practice; but still the physiological facts are so definite as to indicate a precise mode of treatment. For example, no one acquainted with the investigations mentioned above would hesitate in attempting to relieve the tetanic spasms of a case of poisoning by strychnine by repeated doses of hydrate of chloral, or by the administration of chloroform. A practical result of such researches is that the principle of physiological antagonism may serve as a guide to the application of remedies in disease. Thus excessive secretion, say from mucous membranes or from salivary glands, may be modified or arrested by the use of sulphate of atropine, a striking experimental demonstration of which may be seen in the antagonism between bromal hydrate and sulphate of atropine in the rabbit.

John G. McKendrick.

ANTEFLEXION.—A bending forwards of any organ. The term is specially used in relation to the uterus, when this organ is bent forwards at the line of junction of its body and cervix. *See* Womb, Diseases of.

ANTEVERSION.—A displacement forwards of any organ. The term is particularly applied to a change of position of the uterus, in which this organ is bodily displaced in the pelvic cavity, so that the fundus is directed against the bladder, and the cervix towards the sacrum. *See* Womb, Diseases of.

ANTHELMINTICS (ἀντὶ, against; and ἕλμινς, a worm).—Definition.—Medicines which kill or expel intestinal worms.

Enumeration.—The principal anthelmintics are:—Oil of Male Fern; Kamala; Kousso; Oil of Turpentine; Pomegranate Root; Santonica (Worm-seed, so-called), and its active principle, Santonin; Areca; Mucuna; Rue; and drastic purgatives. As purgatives only expel the worms, they are termed *vermifuges*; while the other anthelmintics which kill the worms are called *vermicides*.

Action.—The oil of male fern, kamala, kousso, oil of turpentine, and bark of pomegranate root, act as poisons to tape-worms. Santonica and santonin remove round-worms, and also thread-worms. They were formerly supposed to kill the worms, but it would appear that they only weaken or intoxicate them, so that they are more readily expelled. Castor oil, jalap, scammony, and other purgatives do not kill the worms, but dislodge and expel them, by the increased peristaltic action which they occasion.

Uses.—Drastic purgatives may be used for worms of any sort; areca for both tape- and round-worms; and the other agents for the worms on which they severally act as poisons. Vermicides are generally given after the patient has fasted for several hours, in order that, the intestines being empty, the drugs may act more readily on the worms. A purgative is usually given some hours afterwards, in order to expel the dead worms. As thread-worms chiefly inhabit the rectum, they are most effectually killed by enemata, which may consist of a strong infusion of quassia; salt and water; vinegar and water; solution of the sulphate or perchloride of iron; oil of turpentine; castor oil; decoction of aloes; or infusion of senna. As abundance of mucus in the intestines forms a convenient nidus for the growth of worms, anything that diminishes this tends to prevent their occurrence; and for this purpose preparations of iron and bitter tonics are useful.

T. Lauder Brunton.

ANTHRACOSIS (ἄνθραξ, a coal).—A deposit of black material in the tissues or organs. *See* Lungs, Inflammation of.

ANTHRAX (ἄνθραξ, a coal).—A synonym for carbuncle, and for malignant pustule. *See* Carbuncle; and Pustule, Malignant.

ANTIDOTE (ἀντὶ, against, and δίδωμι, I give).—Definition.—An antidote is any remedy which, by its physical or its chemical effect upon a poison, or in both ways, is capable of preventing or counteracting the physiological effects of that substance (*see* Antagonism). Sometimes, however, the term is used in a more comprehensive sense, so as to include the general treatment of a person affected by a particular poison. Thus, in poisoning by opium, the use of the stomach-pump, enforced exertion, chafing the limbs, and artificial respiration may be included in the general antidotal treatment.

Modes of Action, and Application.—Most antidotal substances form with the poison insoluble or innocuous compounds. Without attempting to give a complete list, the following are examples of the more common poisons and their respective antidotes:—(1) *arsenious acid:* solution of dialysed iron administered freely, or light magnesia; (2) *prussic acid:* newly precipitated oxide of iron with an alkaline carbonate; hypodermic injection of 2 to 4 ♏ of liquor atropinæ sulphatis every half-hour; (3) *oxalic acid:* chalk, common whiting, or magnesia suspended in water; (4) *tartar emetic:* tannin, catechu, or other vegetable astringents; (5) *acetate of lead:* sulphate of magnesium, or the phosphates of sodium and magnesium; (6) *caustic potash:* dilute acetic acid, fixed oils, lemon juice; (7) *corrosive sublimate:* albumin, white of egg, flour, or milk; (8) *mineral acids:* chalk, common whiting, plaster from the walls or ceiling, or carbonate of magnesium; (9) *chloride of zinc:* albumin, milk, or carbonate of sodium.

Vegetable poisons cannot thus be counteracted. If they have been taken in the form of seeds, leaves, or roots, the proper course is to remove them from the stomach or bowels as soon as possible by emetics and purgatives, and at the same time to sustain the flagging strength of the patient by the administration of stimulants. On the other hand, if the alkaloid has been taken, it is so soon absorbed that emetics and purgatives are of little avail, or may even be injurious. In these circumstances we must rely on the administration of the physiological antagonist of the poison (such as chloral hydrate in the case of strychnine-poisoning), and on supporting the strength of the patient. The following are the best antidotes to the vegetable poisons most frequently met with:—(1) *aconite root:* emetic of sulphate of zinc and stimulants; (2) *belladonna leaves, berries,* or *root:* emetic of sulphate of zinc, ammonia, stimulants, and after some time an active purgative; (3) *digitalis:* emetics, stimulants, and the maintenance of the recumbent position; (4) *hyoscyamus leaves:* emetics and stimulants; (5) *hydrochlorate* or *meconate of morphine,* or *any of the preparations of opium:* hypodermic injection of apomorphine; external stimulation by warmth, turpentine or camphor liniments; enforced exertion; artificial respiration, and small repeated doses of sulphate of atropine; (6) *chloral hydrate:* the same as for opium; (7) *strychnine* or *nux vomica:* animal charcoal suspended in water, repeated large doses of chloral hydrate, or chloroform; (8) *atropine:* stimulants, subcutaneous injection of caffeine, morphine, or pilocarpine, or of very minute doses of physostigmine; (9) *calabar bean:* atropine, or stimulants, artificial respiration; (10) *mushrooms:* subcutaneous injection of 2 to 4 ♏ of liquor atropinæ sulphatis, stimulants, castor oil; (11) *tobacco* or *nicotine:* stimulants, subcutaneous injection of minute doses of strychnine. *See* Poisons.

John G. M'Kendrick.

ANTIMONY, Poisoning by.—*See* Tartar Emetic, Poisoning by.

ANTIPERIODICS.—Definition.—Medicines which prevent or relieve the paroxysms of certain diseases which exhibit a periodic character.

Enumeration.—The chief antiperiodics are:—Cinchona-bark and its alkaloids—Quinine, Cinchonine, Quinidine, and Cinchonidine; Bebeeru Bark and its active principle, Beberine; Salicin, Salicylic Acid and its salts; Eucalyptus globulus; and Arsenic.

Action.—The mode of action of antiperiodics is at present unknown.

Uses.—Cinchona, and still more quinine, is almost a specific in the treatment of intermittent fevers, periodic headaches, neuralgias, and other affections caused by malaria. Though less certain in its action than in intermittent fevers, quinine is also the best remedy in the remittent fevers of the tropics, in which, however, it must be given in very large doses. Its action in these fevers appears to be assisted by antipyrin or other antipyretics, given so as to reduce the temperature to the normal during the remission. The other alkaloids of cinchona have a similar action to that of quinine, but they are not so powerful. Beberine is only about one-third as powerful, and is by no means so certain; and the same remark applies to the other remedies enumerated. In some cases of ague and other intermittent affections arsenic proves successful when quinine fails. Emetics and purgatives are useful auxiliaries to quinine in the treatment of ague, and are employed alone for the cure of this disease in some parts of the world where quinine is not available. T. Lauder Brunton.

ANTIPHLOGISTIC (ἀντὶ, against; and φλέγω, I burn).—A term for any method of treatment that is intended to counteract inflammation and its accompanying constitutional disturbance.

ANTIPYRETICS (ἀντὶ, against; and πυρετὸς, a fever).—Definition.—Therapeutic agents which reduce the temperature in fever.

Enumeration.—The principal agents used as antipyretics are—Cold Baths, Cold Applications, Ice; Diaphoretics; Alcohol; Chloral; Quinine; the Salicyl compounds; Antipyrin, Antifebrin, Phenacetin, and allied bodies; Eucalyptol; Essential Oils; Aconite; Digitalis; Green Hellebore; Purgatives; and Venesection.

Action.—The temperature of the body may be reduced, either by increasing the abstraction of heat, or by lessening its production. The direct application of cold, by means of baths, affusion, or sponging, or by enveloping the body in sheets wrung out of cold water, is the most powerful and rapid means of abstracting heat. But the loss of heat which constantly occurs, even in health, by evaporation of the sweat, and the radiation and conduction of heat from the skin, may be increased by the use of diaphoretics, such as salts of potassium, preparations of antimony, or acetate of ammonium; or by such medicines as dilate the cutaneous vessels, so as to allow the heated blood to circulate freely through them, and to become cooled by the external media surrounding the skin. Alcohol, in the form either of wine or spirits, and chloral have an action of this sort, though alcohol also influences the production of heat. Alcohol, quinine, the salicyl compounds, antipyrin, antifebrin, phenacetin, pyrodin, and their allies, eucalyptol, and essential oils lessen the production of heat within the body, probably by diminishing oxidation of the tissues (*see* Alcohol). Aconite, digitalis, and green hellebore reduce the temperature, but their mode of action is not precisely ascertained.

Uses.—Antipyretics act much more powerfully in reducing the temperature of the body in fever than they do in health. They may be used when the temperature has risen either from exposure to a high external temperature, as in thermic fever; in consequence of inflammation, as in pneumonia, pericarditis, or phthisis; or in specific fevers, as acute rheumatism, typhus, and scarlatina. The most rapid and powerful antipyretic remedies are cold baths; next probably come antifebrin, antipyrin, phenacetin, large doses of salicylic acid or salicylate of sodium, and quinine. In acute rheumatism the salicylates are the most useful antipyretics. Quinine seems to act very efficiently in thermic fever when injected subcutaneously.

T. Lauder Brunton.

ANTISEPTICS (ἀντὶ, against; and σηπτικὸς, from σήπω, I make putrid).—Synon.: Antiputrescents.

Definition.—An antiseptic is a substance which prevents or retards putrefaction—that is, the decomposition of animal or vegetable bodies, accompanied by the evolution of offensive gases. The putrefactive change occurs only in dead matter, and requires the presence of moisture, heat, and a ferment. That there is no putrefaction in the absence of moisture is obvious, for bodies, such as albumin and blood, which in the moist state are highly susceptible of putrefaction, may be kept for an indefinite time without change if they be perfectly dry. Heat also has an important influence on putrefaction. At very low temperatures the putrefactive change ceases, while elevated temperatures, such as prevail in tropical climates, are favourable to it. An additional element besides heat and moisture is, however, required, and the opinion generally accepted is that this consists of minute vital organisms, which excite putrefactive decomposition.

Mode of Action.—The substances used as antiseptics act either directly on the bodies in which putrefaction is occurring or might occur, forming with them combinations that are not susceptible of the decomposing action of a ferment; or they act indirectly, by destroying the vitality or otherwise preventing the development and propagation of the organisms of which the ferment is composed. In this respect *antiseptics* may be distinguished from *disinfectants*, the action of the latter being directed only against the exciting causes, and offensive or deleterious products, of a class of changes which are themselves more comprehensive than those implied by the term putrefactive.

Enumeration. — There are numerous chemical agents possessing antiseptic properties, among the chief of which are:—Chlorine, Sulphur Dioxide (Sulphurous Acid), Nitric Oxide, and Peroxide of Nitrogen, as gases; Carbolic Acid, Aseptol, Creasote, Benzol, Sulphites, Hyposulphites, and Hypochlorites, which emit vapours at common temperatures; and Mercuric Chloride (Corrosive Sublimate), Mercuro-Zinc Cyanide, Chloride of Zinc, Chromic, Boric, Tannic and Salicylic Acids, Permanganate of Potassium, Naphthol, Resorcin, and Charcoal, from which no vapour is emitted.

Uses.—1. In therapeutic practice antiseptics are chiefly employed in *the treatment of surgical operations and of open wounds*, to prevent the occurrence of putrefactive decomposition. *See* Antiseptic Treatment.

Those antiseptics are best suited for this purpose which, acting efficiently on the ferment, have no injurious effect on the parts in which the healing process is going on. Gases, except in solution, cannot be locally used, as it would be necessary to enclose the substance to be preserved in an air-tight vessel containing the gas. The volatile antiseptics, which slowly emit a vapour, have been preferred to those which emit no vapour, although among the latter salicylic and boric acids, when properly diluted, being devoid of any irritating properties if applied to inflamed surfaces, present on this account a marked advantage. Latterly a cyanide of mercury and zinc, which is more powerfully antiseptic than those last named, and equally devoid of irritating properties, has been successfully used and recommended by Sir Joseph Lister. Corrosive sublimate, which appears to be one of the most powerful of antiseptics, is also now frequently used in the form of a weak solution, one part in 2,000 parts of water being efficient.

Carbolic acid, which was the first active disinfectant used in surgical operations, still retains its position as one of the most valuable of this class of chemical agents. It is usually employed in solution in water, one part of the pure crystallised acid being dissolved in from 20 to 100 parts of water, and applied as a lotion, and sometimes in the form of spray, diffused through the atmosphere during a surgical operation or the dressing of a wound. The solution may also be used on lint or cotton-wool, for covering the affected part. Antiseptic gauze for a similar purpose may be made by adding one part of crystallised carbolic acid to five parts of common resin and seven parts of paraffin, melted together and applied to coarse muslin, so as to form a thin coating, which, when it has hardened, is used for covering the parts to be protected.

Mercuric preparations, and especially the cyanide of mercury and zinc, have to some extent taken, and will probably still further take, the place of carbolic acid for the purpose under notice. The cyanide, however, although having the advantage of its non-irritating properties, has the defect of insolubility.

Boric acid is prepared as a dressing for rodent ulcers. This is composed of boric acid and white wax, each one part, paraffin and almond oil, each two parts. The boric acid and oil are added to the melted wax and paraffin, and the whole is stirred in a mortar until it thickens, and then set aside to cool and harden, after which it is to be rubbed in the mortar until it acquires the consistence of an ointment. This is thinly spread on fine rag and applied to the wound. The oil separates and is absorbed by lint or rag placed over the dressing, while a firm plaster, which is easily removed when necessary, remains attached to the skin.

Salicylic acid is sometimes substituted for boric acid in the dressing last described; or the finely powdered acid may be merely sprinkled over the part affected. Its very slight solubility in water presents an obstacle to its use in solution, unless something be added to render it more soluble; borax, which is itself a good antiseptic, may be used for this purpose. One drachm of salicylic acid, two drachms of borax, and half an ounce of glycerine, with three ounces of water, form, if aided with a little heat, a clear solution which may be used as an antiseptic lotion.

2. In *medical practice* antiseptics are also employed, either as local applications or as internal remedies. Those which are chiefly available include creasote, carbolic acid, the sulphocarbolates, sulphurous acid, the sulphites or hyposulphites, chlorine water, permanganate of potassium, borax or boric acid, chlorate of potassium, charcoal, salicylic acid, menthol, and thymol. They are principally used for the prevention and treatment of infectious fevers, and in low forms of ulceration of the throat.

3. In using antiseptics for *the preservation of anatomical specimens*, a wider range of chemical agents may be taken, and a selection made of substances that would be inapplicable in tho treatment of the living subject. Arsenious acid, corrosive sublimate, in other than the weak solutions previously noticed, and chloride of zinc in solution, are of service for this purpose; and chromic acid, even when diluted with from five hundred to one thousand parts of water, possesses the property of preserving animal matter from decomposition, as also does a solution of one part of borax in forty parts of water. Alcohol and glycerine are also employed for the preservation of animal and vegetable substances as specimens. For the like purpose, drying, or drying and smoking are used, as in the preparation of bacon, pemican, fish, &c.

4. Antiseptics of a milder nature, such as

common salt, nitre, and sugar, are adopted for *preserving articles of food*.

T. Redwood.

ANTISEPTIC TREATMENT.— Principles:—The 'Antiseptic System' of treatment, introduced by Sir Joseph Lister about 1867, which has in great measure revolutionised modern surgery, depends upon certain postulates, the appreciation and acceptance of which are essential to its successful application. They are:—

I. Septic processes in a wound, and the constitutional changes resulting from them, are caused by the development in it of minute living organisms.

II. These living organisms are (with some few exceptions) always introduced from outside the body, either by the hands or instruments of the operator, by floating particles of dust, by lotions or dressings, or in some similar way.

III. There are means at our disposal, such as the employment of certain germicidal agents, superheating, &c., by which the vitality of these organisms may be destroyed, and their entrance into a wound in an active state effectually prevented, or their influence combated if they be present.

Applications.—In order to carry out an antiseptic operation it is necessary:—

1. To purify the skin of the region to be operated upon, for a considerable distance beyond the part which will be occupied by the wound.

2. To purify the hands of the operators, the instruments, sponges, and everything coming in contact with the wound; and to ensure against their defilement until the operation is completed.

3. To prevent any living septic organisms falling upon the wound during an operation, or to destroy their vitality before the dressing is put on.

4. To apply a dressing containing a store of some antiseptic material; and to change it before this material has been so much washed away by the discharges that a track is left along which septic organisms may be able to spread from the edge or surface of the dressing to the wound.

Materials Employed.—In the present work it is necessary to deal only with generalities, because the details of the treatment are numerous, somewhat complex, and ever changing. Still, it is deemed advisable to add a few words on the concrete side of the question, particularly with respect to the antiseptic substances at present commonly in use, and their chief characteristics.

1. **Carbolic Acid.**—This is occasionally used pure (liquefied by adding 6 to 10 per cent. of water to the crystals) to purify some already septic wounds; or a 1 in 20 watery solution is used for purifying the skin of the part to be operated upon, the hands and instruments of the operator, or in the spray, if that be ever employed. A 1 in 40 watery solution may be used for the sponges, or for bathing the wound during the operation and at the changing of the dressing; but it is less trustworthy and less convenient than a weak mercurial solution. Carbolic acid gauze is not so much used as formerly, but in some cases is still the best dressing at our disposal. A solution of 1 in 10 in oil is useful for lubricating catheters.

Carbolic acid has the advantages of being very diffusible, and of having an attraction for oily and greasy substances, and hence a superiority over mercurial salts for application to the skin; it does not blacken steel or silver instruments. It has the disadvantage of being irritating, and hence causing more effusion of serum than do the mercurial salts. Dressings containing carbolic acid must be kept in airtight boxes.

2. **Mercurial Salts.**—(*a*) *Bichloride of mercury* is employed in solutions of 1 in 500, 1 in 2000, or still weaker. The 1 in 500 solution is used after the carbolic acid lotion, for purifying the skin; for purifying an already septic wound; or as a final application to an aseptic wound at the end of an operation. The 1 in 2000 solution is used for the sponges, and for application to a wound during an operation and at the changing of the dressings. Mercuric chloride forms an insoluble albuminate when mixed with blood; hence the solutions are practically much weakened immediately they come into contact with a bleeding surface. Its advantage is its high germicidal quality; its disadvantages are that a 1 in 500 solution applied for some time to the skin causes vesication, and that if mixed with tap water a large proportion of the salt is thrown down as insoluble chlorides. The latter difficulty is overcome by adding a small quantity of chloride of sodium; or by substituting for the simple corrosive sublimate, the very soluble but decidedly irritating *sal alembroth*, a double chloride of ammonium and mercury, which for a while was very largely employed, but is now almost superseded. It is thus obvious that mercuric chloride alone is not a very suitable substance for the active principle of a permanent dressing. Weaker solutions—1 in 10,000 and 1 in 40,000—are excellent for irrigating abscess cavities, or wounds during the process of suturing.

(*b*) *Biniodide of mercury* has many of the characteristics of the bichloride; but it does not form so copious a deposit of insoluble albuminates when added to blood. It is more irritating, and not at present much used in the pure state.

(*c*) *Cyanide of mercury*, in the form of a kind of double salt with *cyanide of zinc*, is the essential constituent of the latest antiseptic dressing introduced by Lister. This is very insoluble and very unirritating, but at the same time powerfully antiseptic, and at present promises to take the place of all other materials for a permanent dressing.

3. **Boric Acid** is a mild and not very trustworthy antiseptic. It is, however, useful either in the form of boric lint, boric ointment, or boric lotion (a saturated watery solution) for application to superficial granulating surfaces. It is very unirritating.

4. **Salicylic Acid** is not a very powerful antiseptic. It is used in the form of salicylic wool, of various strengths, as an external dressing outside one containing some more potent material.

5. **Iodoform** is a powerful deodorant, but its antiseptic qualities are not great. It is used with great benefit in the form of crystal or powder to stinking wounds.

6. **Chloride of Zinc** in solution—gr. xl to ℥j—is invaluable as an application to surfaces which it is necessary to leave exposed to the air, such as those of the mouth or rectum, or for purifying septic cavities. It usually prevents septic changes for two or three days.

This list might be multiplied almost indefinitely, and would have to include various coal-tar products, such as creoline, which is good for application to ulcers, naphthaline, &c., oil of eucalyptus, thymol, iodol, iodine, and countless others, but it is impossible to mention in detail more than those most commonly in use.

USE.—(1) The steps of a simple operation, *where the skin is unbroken*, such as the removal of a tumour or the opening of an abscess, will now be described as an illustration.

The skin of the part to be operated upon, and the hands of the operator, are washed first with soap and water, then with 1 in 20 carbolic acid solution, and then with 1 in 500 sublimate solution. The instruments should have been placed some time previously in a flat tray filled with carbolic acid solution 1 in 20; and a large supply of sublimate solution, 1 in 2000, should be prepared, in which the sponges are to be washed out, and the hands of the surgeon and his assistants dipped from time to time. It is convenient to surround the part to be operated upon with towels wrung out of one of the antiseptic solutions, so that instruments may not be thoughtlessly laid down upon an unpurified surface. During the operation it is advisable to irrigate the wound occasionally with some of the 1 in 2000 sublimate solution by means of a sponge, and it is an additional safeguard, at the end of the operation, to sponge it over with some of the 1 in 500 sublimate solution. Finally during the application of the sutures some of the 1 in 2000 solution should be dropped over the wound from a wet sponge or an irrigator; and this is to be kept up until the incision is covered by the deep part of the dressing.

Before changing an antiseptic dressing, scissors and forceps, and a piece of rag or wool should be placed in a bowl of the antiseptic solution preferred, and the fingers of the surgeon should be purified. As soon as the deep part of the dressing is removed, some of the solution should be dropped upon the wound by means of the rag or wool, and the process should be frequently repeated until the deep part of the new dressing is in position.

By most surgeons the spray has now been completely abandoned; some still employ it throughout their practice. The present writer reserves its use for cases like those of empyema, where large volumes of air, possibly bearing particles of dust, are sucked into an inaccessible cavity.

(2) *If the skin have been previously injured*, as in a compound fracture, or in abscesses which have burst, the strongest antiseptic solutions must be applied with great vigour to the exposed surface, their influence being often advantageously supplemented by the use of the sharp spoon or the nail-brush.

Besides these matters, thus briefly hinted at, the acceptance of the antiseptic principle has effected marvels in the improvement of the hygiene of hospital wards, inasmuch as septic wounds are now dressed at frequent intervals with the most suitable antiseptic and deodorising dressings, the discharges not being allowed to collect and fester as in former times beneath putrid poultices and water-dressings. And it should effect still more when it is thoroughly carried out in all the details of the sick-room, by proper ventilation, by the methodical purification of bed-pans, catheters, urinals and other utensils, and in a host of other ways too numerous to mention.

RICKMAN J. GODLEE.

ANTISPASMODICS (ἀντὶ, against, and, σπάσμα, a spasm).—DEFINITION.—Medicines which prevent or allay spasm.

ENUMERATION.—Antispasmodics may be arranged in groups as follows:—Valerian, Valerianic Acid and its salts; Musk, Castor, Asafœtida, Sumbul and Galbanum; Camphor, Brominated Camphor, Oil of Amber; Ammonia and its Carbonate; Alcohol, Ether, Acetic Ether, Chloroform, Nitrite of Amyl; Bromide of Potassium, Bromide of Ammonium; Conium, Lobelia, Opium, Gelsemium, Indian Hemp, Belladonna, Stramonium; and the Essential Oils. As adjuvants may be mentioned—Cold Baths, moderate Exercise, Friction, Heat, and Moisture; and also Quinine, Arsenic, Zinc, and Silver.

ACTION.—Certain nerves and nerve-centres, when excited, produce contraction of voluntary or involuntary muscular fibres; other nerves and centres arrest movements; and by the combined action of these two systems the motions of the various contractile structures in the body are regulated, and subordinated to the requirements of the organism as a whole. Excessive contraction or spasm of one part of the body may therefore arise either from excessive action of the motor, or deficient action of the inhibitory centres. Spasm may affect the involuntary muscular fibres of the intestines—as in colic; of the vessels—as in some forms of headache, and in vaso-motor neuroses of the uterus and bladder; of the bronchi—as in spasmodic asthma; of single voluntary muscles, or groups of muscles—as in various forms of cramp; or it may involve the muscular system generally—as in tetanus, epilepsy, and hysteria. Antispasmodics may act by lessening the irritability of motor centres, as, for example, bromide of potassium and conium; or by stimulating those portions of the nervous system which restrain and co-ordinate movements, as alcohol probably does. There are no direct experiments to show the action of antispasmodics on the inhibitory centres; but it seems probable that they have such an action, although it may not be confined to these parts alone. Thus small doses of alcohol and ether, which stimulate the nervous system generally, and usually increase motor activity, will restrain and co-ordinate excessive muscular action, as in colic, nervous agitation, trembling, and hysteria. It is at present impossible to localise the part of the nervous system affected by valerian, asafœtida, and other drugs of this class. As spasms occur when the nervous system is deficient in power, nervine and general tonics, such as quinine, zinc, and iron, are often found to be useful adjuvants.

Uses.—In such convulsive diseases as epilepsy, laryngismus stridulus, and infantile convulsions, bromide of potassium is the most powerful antispasmodic; in hysteria—valerian, asafœtida, and the bromides; in chorea—arsenic, conium, copper, and zinc; in spasmodic asthma—lobelia and stramonium; in spasm of the blood-vessels—nitrite of amyl. In all spasmodic affections, cold baths or sponging, exposure to sunlight, moderate exercise, and a plain but nutritious diet should be employed; and late hours, a close atmosphere, exhausting emotions, or excessive bodily or mental work should be avoided.

T. Lauder Brunton.

ANTRUM, Diseases of.—*See* Nose, Diseases of.

ANURIA. — Absence of urination, whether from suppression or retention of urine. *See* Micturition, Disorders of; and Urine, Suppression of.

ANUS, Diseases of.—The principal affections of this part are:—1. Congenital Abnormalities; 2. Epithelioma; 3. Irritable Sphincter Ani; 4. Irritable Ulcer; 5. Prolapsus; 6. Prurigo; and 7. Tumours and Excrescences. For Fistula in Ano *see* Rectum, Diseases of.

1. **Congenital Abnormalities** (*atresia*) may be classed as follows:—1. Imperforate anus without deficiency of the rectum 2. Imperforate anus, the rectum being partially or wholly deficient. 3. Anus opening into a *cul-de-sac*, the rectum being partially deficient. 4. Imperforate anus in the male, the rectum being partially deficient, and communicating with the urethra or neck of the bladder. 5. Imperforate anus in the female, the rectum being partially deficient, and communicating with the vagina or uterus. 6. Imperforate anus, the rectum being partially deficient and opening externally in an abnormal situation by a narrow outlet. 7. Narrowness of the anus. These imperfections can be remedied, if at all, only by operation.

2. **Epithelioma.**—The anus, like other parts where a junction takes place between the skin and mucous membrane, is liable to epithelioma. It is easily recognised by the ordinary characters of the sore. Warty growths and flaps of skin at this part are subject to this form of degeneration. The treatment applicable to this disease is to remove the growth by excision.

3. **Irritable Sphincter Ani.**—In this complaint the anus is strongly contracted and drawn in by the action of the sphincter. Any attempt to examine the part produces spasm, and the finger passed through it is tightly grasped as if girt by a cord. In cases of old standing the muscle becomes hypertrophied, and forms a mass encircling the finger like a thick unyielding ring. This state is the source of serious trouble in defecation, owing to the expulsive power of the bowel being insufficient to overcome the impediment caused by the muscle to the passage of the fæces. Irritability of the sphincter, independent of fissure or ulcer, occurs generally in hysterical females, and is relieved by mild laxatives, the local application of cocaine or an opiate ointment, and the occasional passage of a bougie coated with a sedative ointment.

4. **Irritable Ulcer.**—This is a small superficial sore, situated just within the circle of the sphincter, usually at the back part, commonly known as *fissure*, from its appearance in the contracted state of the part. The fæces passing over the sore excite spasm of the muscle, and cause a sharp burning pain which lasts for two or three hours. The distress often does not come on till an interval of ten minutes or more has elapsed after defecation. The pain is sometimes so acute that patients resist an action of the bowels, and allow them to become costive. The irritable ulcer occurs usually in middle life, and is more frequent in women than in men. It seldom gets well under the influence of local applications, but an incision through

the centre of the sore sets the muscle at rest, and allows the part to heal. Forcible dilatation of the sphincter with the fingers under an anæsthetic is a very effective mode of treatment. When the suffering is moderate, a cure may be attempted by giving a laxative to ensure soft evacuations, by enjoining rest in the recumbent position, and by the application of an ointment containing morphine, belladonna, or cocaine.

5. **Prolapsus.**—*See* Rectum, Diseases of.

6. **Prurigo.**—Itching, though a common symptom in disorders of the lower bowel, may occur as a distinct affection, a neurosis liable to paroxysms. It is caused by worms in the rectum, and by congestion of the hæmorrhoidal veins. Patients suffer more after taking stimulating drinks and when heated in bed. The itching is extremely teasing and annoying, especially at night, keeping the sufferer awake for hours. Friction aggravates the mischief, excoriates the skin at the margin of the anus, and causes it to become dry, harsh, and leathery. As regards treatment, stimulants and condiments are to be avoided. The bowels should be regulated, and the part should be washed with soap and water after each evacuation. Every effort should be made to avoid friction. Cotton-wool should be used after defecation in the place of paper. A piece of cotton-wool soaked in oxide of zinc lotion may be kept applied to the anus, or the part may be smeared with some mercurial ointment, such as one of calomel (ʒj) and vaseline (℥j). Lotions of cocaine and glycerine, of borax and morphine, or of carbolic acid, are often efficacious. In weak persons quinine and arsenic help the cure.

7. **Tumours and Excrescences.**—Besides the flaps and folds of integument consequent on external piles, tumours of a *fibrous* texture sometimes form in the subcutaneous areolar tissue, which as they increase become pedunculated. They are usually small in size, lobulated, and have a firm feel. These growths may be easily and safely removed by excision. *Papillomata* are liable to be developed around the anus, and sometimes grow so abundantly as to constitute a large cauliflower-looking excrescence. They then form projecting processes of various sizes, densely grouped together, with their summits isolated, expanded, and elevated on narrow peduncles. They give rise to a thin, offensive discharge. They probably originate in want of cleanliness. In some persons there is so strong a disposition to the formation of warts, that it is difficult to prevent their growth. They require to be removed by excision, the quickest and most effectual mode of treatment. Flattened growths from the skin, commonly called *mucous tubercles*, a secondary result of syphilis, are liable to occur around the anus. They yield readily to the local application of mercury and general specific treatment. *See* Mucous Tubercles.

T. B. Curling. Frederick Treves.

ANXIETAS.—Anxiety or distress, whether subjectively felt, or expressed in the features, attitude, or general behaviour. The term is also especially associated with a peculiar sensation experienced in the region of the heart. *See* Præcordial Anxiety.

AORTA, Diseases of.—The diseases to which the aorta is liable may be thus considered:—1. Aortitis, Acute and Chronic; 2. Atheroma; 3. Primary Fatty Degeneration; 4. Primary Calcification; 5. Coarctation; 6. Simple Dilatation; and 7. Aneurysm.

1. **Aortitis.**—*Acute Aortitis* (*Hyperplastic Arteritis*) is exceedingly rare. It may result from the direct irritation of an atheromatous aorta by a thrombus or an embolus, in persons of gouty diathesis; but has never been observed as an extension of acute endocarditis. The *morbid changes* consist in hyperæmia, with thickening and softening of the coats of the vessel, and deposit of fibrin upon its internal surface. The ascending portion of the arch is the part most frequently affected. The *symptoms* are acute substernal pain, with oppression, palpitation, quick and feeble pulse, and elevated temperature. With these symptoms may be associated a harsh systolic murmur, originating at the seat of inflammation, and transmitted to a distant part of the aorta.

Sub-acute and *Chronic Aortitis* (*Endarteritis*).—These are the usual forms of inflammation of the aorta. The disease may be general, arising from a blood-dyscrasia such as gout or syphilis, from pyæmia, or from various septic agents; but it is usually limited to a definite portion of the vascular surface, being the result of local irritation.

Ætiology.—Excessive and continued strain of the vascular walls is, according to its degree, the most frequent cause of subacute and chronic aortitis. Hence, the portion of the arterial system most directly affected by the impulse of the left ventricle, namely, the arch of the aorta, is that in which inflammatory irritation is first, and often exclusively, exhibited. Labour of any kind requiring great and repeated muscular effort whilst the breath is held, must necessarily subject the aorta to extreme tension, partly through the obstruction arising from the pressure of the contracted muscles upon the subjacent arteries, and partly from the back-pressure in the distended veins. Hence, sledgers, rammers, ship-porters, &c., are those who most frequently suffer from the effects of aortitis. As a necessary result of such efforts the left ventricle soon becomes hypertrophied, and the evils arising from vascular tension are thereby proportionately increased. Furthermore, the free use of alcoholic stimulants, in which such labourers habitually indulge, contributes to the same result. The British soldier has been especially liable to the evils above sketched, owing to a vicious system of forced drill with a breathing-capacity diminished by faulty construction of his dress and accoutrements.[1]

Anatomical Characters. — Sub-acute aortitis occurs in disseminated patches, and involves all the coats of the vessel. These are infiltrated with leucocytes at an early period; become soft and tumid, assuming a bluish-white tint; and, owing to loss of normal elasticity, project outwards, thus causing unevenness or pitting of the internal surface. In the aorta the inflammation is usually primary; but exceptionally it may be produced by the mechanical irritation of an embolus derived from an inflamed focus. Inflammatory softening is a frequent cause of aneurysm at all periods of life; and in the young it is the ordinary precursor of that disease.

In chronic aortitis, which is the most common form of the disease, the internal coat is alone involved. The outer portion of the intima exhibits the result of irritation in the abundant production of new cells. These cells occupy the fusiform spaces between its lamellæ, and, gradually distending them, ultimately project the internal and unaffected portion of the tunic into the lumen of the vessel. The prominence so caused is comparatively solid, presents a faint bluish tint, and constitutes the condition described as *sclerosis*. The thickened intima is prone to undergo granular and fatty disintegration, and the consecutive change is called *atheroma*. Dr. Mott has suggested that this process may be partly accounted for by the fact that the deeper layers of the inner coat of the larger arteries are probably nourished by the *vasa vasorum*, through the fenestræ of the elastic lamina. Where these nutrient vessels are diseased, as in Bright's disease and syphilis, where the walls are often greatly thickened—possibly almost obliterated, the parts indicated are imperfectly supplied with blood and undergo degenerative changes.

2. **Atheroma.**—This morbid condition is most common in the first portion of the aorta.

Anatomical Characters.–Atheroma commences with inflammatory overgrowth by multiplication of the cells of the outer portion of the intima, as described in a preceding paragraph. The neoplasts, from their situation, readily undergo fatty change and caseation; the septa of unaltered tissue intervening between them soon lose their vitality and are absorbed; and the disease thus spreads, while it advances by the same process towards the internal surface of the vessel. Examined microscopically, atheromatous matter is found to consist of fat-granules, crystals of cholesterin, and tissue-débris. At an early stage the disintegrating process makes its way towards the lumen of the vessel, and a rupture of the innermost layers of the intima takes place, forming what is termed an *atheromatous ulcer*. From this may result a false aneurysm.

In the most advanced stage of atheromatous change many patches undergo calcification by deposit of lime-salts in the altered cells. The calcareous lamellæ so formed, being concentric with the vessel, and contracting by loss of their liquid constituents, may erode the intima by their sharp edges. From the injury thus inflicted aneurysm may arise, or interstitial thrombosis, by which the vessel may be entirely blocked and gangrene of the extremities produced. In consequence of the foregoing changes the vessel loses its elasticity and becomes dilated; its internal surface is mottled with yellow or fawn-coloured plaques and patches of various sizes, being also rough, spiculated, and fissured; and thus the condition described by Virchow under the name of *endarteritis chronica deformans* is established.

The uric acid and oxalic acid diatheses favour these changes, not only by stimulating the minute arteries to contract, and so raising the blood-pressure in the larger vessels, but likewise by furnishing material for cretification. The subjects of constitutional syphilis are liable to 'ulcerated steatomatous' (atheromatous) changes of the intima.

3. **Primary Fatty Degeneration.**—Virchow has described, under the name of *fatty erosion*, a form of fatty degeneration of the cells of the internal coat, unpreceded by inflammation, commencing on the free surface, and gradually extending outwards. The internal surface of the vessel is marbled with minute yellow dots, which are groups of fatty cells; these undergo liquefaction; and disintegration of the internal coat, followed by aneurysm, is the usual result.

4. **Primary Calcification.** — Exceptionally, in the distant portions of the aorta the muscular fibre-cells of the middle coat are liable to calcification, as a remote result of endarteritis. Owing to the transverse arrangement of the calcified cells, fissuring of the middle coat under the pressure of the blood-current, and dissecting aneurysm, are ordinary results of this change. Finally, the entire middle coat, and even all three coats of the artery, may be infiltrated with lime-salts as a primary change. This is most probably due to precipitation of these salts from the congested *vasa vasorum*, in consequence of the escape of their ordinary solvent, carbonic acid.

5. **Coarctation** or **Stenosis.**—This condition may be either *congenital* or *acquired*.

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[1] Also by the constrained and fixed position in which the walls of the chest are placed when the shoulders are forced backwards, with the view of producing the appearance of an expanded chest. —Ed.

Congenital stenosis of the aorta is most frequently located at the point of junction of the *ductus arteriosus*, and is of very limited extent; in many cases presenting the appearance of a linear constriction, or of a perforated diaphragm. In a few examples, the vessel, at the seat of contraction, has been entirely closed and converted into a ligamentous cord. On the cardiac side of the constriction the aorta is dilated, and often thickened and atheromatous, whilst on the distal side it is reduced in calibre as far as the junction of the collateral vessels. Congenital stenosis of the aorta is compatible with life of moderate duration. In 24 out of 38 cases analysed by Dr. Peacock the age attained varied from twenty-one to fifty years. The diagnosis of the condition rests mainly on disproportionate pulsation of the arteries arising from the aorta on the cardiac, as contrasted with those on the peripheral side of the obstruction; and on the enlargement of the collateral vessels, namely, the transverse cervical, internal mammary, and intercostals. The ordinary consequences are exhibited in dilated hypertrophy of the left ventricle, and relative inadequacy of the aortic valves. Death usually occurs from progressive debility and failure of the left ventricle; from pulmonary congestion; from rupture of the aorta or one of its dilated branches; or from acute inflammatory change in the heart or aorta. Congenital stenosis of the entire arch may result from imperfection of the inter-ventricular septum or patency of the foramen ovale allowing the blood to take an exceptional course.

Congenital narrowing of the aorta *throughout its course* was described by Rokitansky and Virchow. The latter pointed out its existence in women who have through life presented the signs of persistent chlorosis (*see* CHLOROSIS). In many of these cases valvular disease of the heart, especially stenosis of the mitral orifice, has been observed.

In the *acquired* form, stenosis of the aorta at any portion of its course may result from inflammatory thickening or calcareous change of the coats of the vessel, followed by thrombosis; or it may follow the natural cure of an aneurysm. The aorta may be much reduced in calibre without being disproportionately narrowed. Such will be its condition in connexion with mitral inadequacy in early childhood, should the patient survive a few years. In such cases the left ventricle will have become dilated and hypertrophied, and a marked disproportion will be observed between the force of cardiac and that of radial pulsation. This circumstance, taken in conjunction with the age of the patient, the existence of disease at the mitral orifice, and hypertrophy of the left ventricle, would warrant the positive diagnosis of narrowing of the aorta.

6. **Simple Dilatation.**— This disease consists in a uniform enlargement of the vessel or a portion of it, from impairment or loss of its normal elasticity; and depends primarily upon arterial obstruction or resistance beyond its seat, and directly upon consecutive hypertrophy of the left ventricle. The continued tension, to which the walls of the aorta are subjected between these two opposing forces, necessarily leads to progressive impairment of nutrition and loss of elasticity in its middle coat. The immediate consequence of this change is exhibited in further hypertrophy of the left ventricle; and its remote effects in still further impairment of nutrition and deterioration of tissue in the vascular tunics, through the increased tension to which they are now exposed. No elementary change of structure is, however, discoverable. Simple dilatation of the aorta commences in the ascending portion of the arch, and to this it is usually limited; but it occasionally extends into the transverse portion. The other portions of the vessel are never dilated, except in association with atheromatous change. The condition under notice is manifestly in close relationship with inflammatory irritation of the vessel. It has, however, a distinct pathological existence, analogous to that of the early stage of vesicular emphysema of the lung.

No morbid results, with a single exception, are directly traceable to simple dilatation of the aorta. But, should the dilatation extend into the transverse portion of the arch, and engage especially its superior wall, the primary branches may become tortuous, and exhibit abnormal pulsation in the neck, simulating aneurysm. In a noteworthy example observed by the late Dr. Hayden the existence of this pulsation on *both* sides of the neck, and the facility with which it was arrested by forcibly extending the neck and shoulders, and so unbending the vessels, sufficed to establish the diagnosis. Tortuosity of the cervical arteries, dependent upon a local dilatation of the aorta, may be confined to one side of the neck.

Simple dilatation of the aorta most frequently occurs in connexion with the contracted or granular form of chronic renal disease. It may, however, likewise arise from simple functional hypertrophy of the left ventricle dependent upon habitual vascular excitement; or from dilated hypertrophy consecutive to inadequacy of the aortic valves.

7. **Aneurysm.**—ÆTIOLOGY AND PATHOLOGY.—Aneurysm of the aorta is essentially a disease of the middle period of life. Of 92 cases observed or analysed by the late Dr. Hayden, 60 occurred between the ages of thirty and fifty years; 12 over fifty; and 5 under thirty years. Thus, whilst deterioration of the arterial coats, as typified in atheroma, is most common after the age of sixty, one of its ordinary consequences, aneurysm, belongs to an earlier period of life. The apparent discrepancy

may be explained by the more frequent employment of men under fifty in severe labour, and their greater capacity for extreme muscular effort earlier in life, the condition of the arterial wall which favours aneurysm having been already established. Aortic aneurysm is more common amongst males than females in the proportion of about 8 : 1—a difference no doubt due to the more active and laborious habits of the male sex. Soldiers, mechanics, and porters suffer from it in larger proportion than persons of other callings; and in most instances the first symptoms of aneurysm of the aorta may be traced to a great muscular effort, involving vascular strain, or to a severe shock or blow, causing a direct contusion.

Aneurysm of the aorta is always consecutive to disease of its coats. Inflammatory softening, atheroma, and calcification are the usual antecedent conditions, and in exceptional instances primary fatty or calcific transformation of the internal and middle coats; whilst a definite overstrain or a direct contusion of the vessel is frequently the immediate cause of the disease.

Anatomical Characters.—Aortic aneurysm may be presented under the following forms, viz., (*a*) *true;* (*b*) *false* (*circumscribed*, and *diffused* or *consecutive*); (*c*) *dissecting*; and (*d*) *varicose.*

a. True aneurysm of the aorta is rare; it may be either fusiform or saccular. It is essentially transitional, leading to the false variety of the disease; and differs from simple dilatation of the aorta only by its sharp limitation, and by the existence of inflammatory products in its walls. True aneurysm never contains clots, save by incidental thrombosis; and rarely, as such, attains dimensions capable of producing extrinsic symptoms or signs. It may, however, unlike simple dilatation, be the cause of valvular inadequacy, and so give rise to a murmur of reflux at the orifice of the aorta.

b. False aneurysm is either *circumscribed* or *diffused. Circumscribed false aneurysm* (or, as it is also termed, *false aneurysm*) is the most common form of the disease in connexion with the aorta. It is necessarily confined to a portion of the circumference of the vessel, the yielding of which relieves the remainder from extra tension. Hence, it is usually saccular in general outline; but, owing to unequal resistance at different points of its surface, it may, and commonly does, present one or more secondary prominences. The internal and middle coats are usually broken;—the adventitia supplemented by the surrounding structures, more or less condensed, forming the sac.

Disintegration of the inner coat, already in a state of atheromatous change by mechanical strain or vascular tension, is ordinarily the immediate cause of false aneurysm. Ulceration of the intima from fatty erosion may also cause it, as well as progressive arterio-sclerosis. Rupture of the coats of the vessel by mechanical strain is usually indicated by definite symptoms of the utmost significance, namely, a feeling of something having given way within the chest or abdomen; followed by faintness often amounting to syncope, dyspnœa, palpitation, and occasionally hæmoptysis. These symptoms of shock usually subside within a period of one to two hours, but the patient is thenceforward incapable of his accustomed exertion, being easily put out of breath, and distressed by excitement or rapid movement, especially that of ascent; there is likewise a fixed pain at some point of the chest, back, or abdomen. A fusiform false aneurysm may become 'invaginating' by abruptly expanding and ensheathing the artery at its proximal or distal side, or in both these situations.

Diffused false aneurysm (or, as it is otherwise called, *diffused aneurysm*, or *consecutive aneurysm*) is produced by escape of blood from the artery, and its diffusion to a greater or less extent amongst the surrounding structures, according to their previous condition or anatomical arrangement. It may be the result of mechanical violence by strain or shock to the artery in a previously diseased condition; or of progressive disintegration of the sac of a circumscribed aneurysm. In the latter case the diffusion of the extravasated blood is usually limited by antecedent adhesive inflammation of the surrounding parts, where, as in the transverse portion of the arch of the aorta, the position of the aneurysm is favourable to that process. Under ordinary circumstances diffused false aneurysm of the aorta cannot occur within the pericardium, owing to the isolation of that portion of the vessel, and the fragile structure of its serous investment. Hence, a yielding of the sac proper in this situation is, in most instances, followed by instant death from hæmorrhage into the pericardium and paralysis of the heart. In a few recorded cases, owing to previous adhesion of the pericardium, the patients survived rupture of the sac in this situation for several days.

Diffused false aneurysm of the abdominal aorta is frequently formed by irruption of blood into the retro-peritoneal tissue, between the layers of the transverse meso-colon or the mesentery, or into the fibrous envelope of the psoas muscle. When the aneurysm grows backwards the sac is quickly eroded by pressure against the vertebræ, the naked and carious surface of which then forms its posterior boundary. Diffusion in such cases rarely occurs until the vertebræ are entirely absorbed; the blood may then escape into the spinal canal, causing general paralysis and immediate death. Diffusion may also occur amongst the muscles and areolar tissue of the loins, or behind the diaphragm into either pleural cavity, usually the left. Any portion of the aorta outside the pericardium may be the seat of diffused false aneurysm, but the transverse portion of the arch and the abdominal aorta are the parts most frequently affected.

Consecutive false aneurysm, consisting in a primary bulging of all the coats of the artery, the internal and middle coats having subsequently given way, constitutes the ordinary form in which false aneurysm originates: it therefore demands no further notice here.

c. Dissecting aneurysm consists in a breach of the internal and middle coats, and a subsequent detachment of these from the external tunic, by the force of the blood-current, to a variable extent over the length and circumference of the vessel; or in a splitting of the middle coat by the same agency. This form of aneurysm is of two kinds—that with a single aperture through which the blood enters the abnormal channel and returns to the artery; and that which exhibits two openings, one by which the blood escapes from, and another through which it re-enters the vessel. The former is the more usual variety of dissecting aneurysm; and it is likewise the more grave, because liable at any moment to terminate fatally by rupture of the external coat.

Any portion of the aorta may be the seat of dissecting aneurysm; the ascending part of the arch is most frequently affected, and next in order of frequency comes the abdominal aorta. The primary lesion consists in a transverse rent of the internal and middle coats; when this is close to the heart, the outer or the anterior wall of the vessel is its usual site, and detachment of the tunics rarely extends beyond the ascending portion of the arch, and seldom engages more than a limited area of its circumference. In this situation, too, an aperture of re-entrance is rarely formed, the disease usually terminating by rupture of the external coat within the pericardium. When, on the contrary, the second curve of the arch, or any portion of the aorta beyond this point, is the seat of primary lesion, separation of the coats is usually found to extend along the remainder of the length of the vessel and over the whole or greater part of its circumference, whilst the blood has re-entered through an opening in one or both common iliac arteries.

The establishment of a second aperture of communication with the artery is an attempt at 'natural cure;' and when this happens the patient may survive for many years. Amongst the eccentricities of dissecting aneurysm may be mentioned detachment of the laminated clot from the walls of the sac proper, and subsequent escape of blood by rupture of the latter; and separation of the mucous from the muscular coat of the œsophagus, with irruption of blood into the stomach. Dissecting and ordinary false aneurysm may coexist, the former being usually a consecutive lesion, and the immediate cause of death.

d. Varicose or *anastomosing aneurysm* consists in a direct communication between an aneurysm of the aorta and (*a*) one of the chambers of the heart; (*b*) the pulmonary artery or one of its branches; or (*c*) one of the venæ cavæ or innominate veins. This form of the disease is necessarily consecutive, and usually late as to the period of its development. In the great majority of recorded examples the primary aneurysm was connected with the ascending portion of the arch, and in a large number it arose from one of the sinuses of Valsalva. The communication, with few exceptions, is formed with one of the chambers of the heart, the pulmonary artery, or the descending vena cava. Of the cavities of the heart, the right ventricle is most often implicated; next in order is the right auricle; then the left ventricle; and lastly the left auricle. The pulmonary artery and the descending cava have been frequently involved, as might have been inferred from their close relationship to the ascending aorta; the innominate veins in fewer instances, and only when the aneurysm engaged the upper portion of the arch. An aneurysm of the abdominal aorta has communicated with the inferior vena cava in a few cases. In the process of formation of a varicose aneurysm of the aorta, the apposed surfaces are agglutinated by adhesive inflammation; and the composite septum is subsequently eroded by progressive absorption, or suddenly rent by the force of the arterial current. The immediate effects of communication are engorgement and increased tension of the receiving chamber or vessel; diminished blood-current and vascular tension in the aorta and its branches; and admixture of arterial with venous blood when the right side of the heart or one of the great veins is the seat of discharge. The special symptoms and signs by which the disease is characterised have direct reference to these results. Death has followed most rapidly in those cases in which the aneurysm had established a communication with the pulmonary artery or the left auricle.

Effects upon the left ventricle.—Hypertrophy of the left ventricle cannot be regarded as a consequence of aneurysm of the aorta. The association, when it exists, is accidental; hypertrophy depending upon antecedent or consecutive disease or inadequacy of the aortic or the mitral valves, chronic atheroma of the aorta, granular degeneration of the kidneys, or excessive functional activity.

SYMPTOMS.—The symptoms of aortic aneurysm may be discussed under the three heads of: (*a*) Pain; (*b*) Excentric Pressure; and (*c*) Tumour.

Pain.—The pain of aneurysm is of two kinds, *intrinsic* and *extrinsic*. The former is due to subacute inflammation and tension of the sac, and varies with intra-vascular pressure. It is dull, aching, and localised, and promptly alleviated by measures which depress the circulation or reduce local tension. Extrinsic pain usually arises from pressure upon adjacent nerves, and may be direct or reflex. This kind of pain has the characters of a diffused and aggravated neuralgia, being paroxysmal, and wandering to a greater or less extent over the back, chest, shoulders, arms, abdomen, and thighs. In the abdomen, when due to pressure upon the splanchnic nerves or tension of the solar plexus, it is of the most excruciating character. The extrinsic pain of aneurysm may be fixed and boring. When of this character, it is usually located in the back, and arises from progressive absorption of the vertebræ.

Excentric Pressure.—The parts affected by the pressure of an aneurysm, and the symptoms thereby developed, vary according to its situation and the direction of its growth. Parts which are exposed to counter-pressure, or are otherwise fixed, suffer most; whilst those which are flexible or movable are less injuriously affected. The symptoms have reference to the respective functions of the organs or structures pressed upon; whilst their severity is in direct proportion to the importance of those functions, and the degree of pressure exercised. Structures subjected to the remittent pressure of an aneurysm are slowly removed by absorption, but between the sac and the resisting surface union has been previously established by adhesive inflammation. Hence the sac itself is at the same time absorbed, and escape of blood will inevitably occur where further resistance is not presented. When serous cavities are laid open by this process, entrance is effected by a rent; and if the cavity be large, *e.g.* the pleura or the peritoneum, death by hæmorrhage, almost instantaneous, is the result; in case of irruption into the pericardium or the spinal canal, death occurs with equal rapidity from compression and paralysis of the contained organ. Communication with a mucous canal or with the cutaneous surface is effected by a process of sloughing, and bleeding occurs by 'leakage,' in variable quantity and at uncertain intervals, till the slough is finally detached, when death by copious hæmorrhage immediately ensues. The irruption of an aneurysm into a gland-duct, such as the ureter or one of the biliary passages, may be fatal by obstruction and suspended secretion, the duct and its tributaries having been blocked by coagulum. Pressure upon the thoracic duct proves slowly fatal by inanition. When the aneurysm opens into a vein, a varicose aneursym, characterised by special symptoms and signs, and of greater or less gravity according to its situation, will be the result.

The symptoms of nerve-pressure vary according to the nerves affected. Thus, pressure upon the roots or branches of sentient nerves is attended with neuralgic twinges or paroxysms referred to the seat of their peripheral distribution, and, when the pressure is extreme, with numbness in the same situation. Irritation of motor nerves is indicated by spasm or paralysis, according to the degree of pressure, of the muscles supplied by them. Irritation of the cervical sympathetic, or of its cilio-motor roots, is revealed by dilatation of the pupil on the corresponding side; or, if the pressure be such as to cause paresis, by contraction of the pupil with ptosis, hyperæmia, hyperæsthesia, and elevation of temperature in the eye and corresponding side of the face. The effects of pressure upon the pulmonic and cardiac plexuses have been less precisely determined, owing to the difficulty of distinguishing the symptoms due to this cause from those which arise from direct pressure upon the trachea or bronchi, the great vessels, or the heart, or from structural disease of the heart or the coronary arteries; but that the paroxysms of bronchial spasm and of angina, so often witnessed in connexion with aneurysm of the arch of the aorta, are in some degree dependent upon pressure on the pulmonary and cardiac nerves, and occasionally are due to it exclusively, there can be no doubt. The symptoms arising from the pressure of an aneurysm upon the pneumogastric or recurrent nerve of either side have reference to the larynx, and are eminently characteristic. They are of two kinds, according to the degree of pressure; namely, those due to spasm, and those to paralysis, of the laryngeal muscles on one or both sides. They are presented under the several forms of dysphonia, aphonia, stridor, metallic cough, and paroxysmal dyspnœa. The latter is frequently of the most urgent character, and sometimes is the immediate cause of death.

Adjacent organs, such as the heart, lungs, liver, and kidneys, are occasionally displaced by an aneurysm, the direction being determined by that of the pressure, and in part also by the direction in which the organ is movable. Obstruction or occlusion of adjacent arteries, as indicated by diminished or suppressed pulsation, may likewise result from the pressure of an aneurysm. Pressure on a vein is evidenced by venous stasis distal to the seat of obstruction; upon the pulmonary artery, by engorgement of the right chambers of the heart and general venous congestion. Obstruction or occlusion of either bronchus or of one of its primary branches is evidenced by distress in breathing or shortness of breath; by bronchial breathing over the seat of compression; and by diminution or suppression of respiratory sound in the corresponding portion of the lung. Inasmuch as the symptoms of excentric pressure may be produced by a tumour of any kind, they possess, in regard to aneurysm, a diagnostic value only correlative to other and more positive evidence of that disease.

Tumour.—The tumour formed by an aneurysm of the aorta is fixed, smooth, and compressible. It is alternately tense and soft, in unison with cardiac pulsation; and is especially characterised by a movement of general and equal expansion, synchronous with the impulse of the heart. It is further distinguished by a remarkable liability to vary in the rate and direction of its growth, retrocession at one point coinciding with enlargement at another; a new set of symptoms being at the same time developed by its encroachment upon fresh territory. In the progress of cure the tumour may become solid, incompressible, and uneven, by deposition of laminated fibrin within the sac.

Physical Signs.—The physical signs of aneurysm of the aorta are those which may be elicited by *inspection*, *palpation*, *percussion*, and *auscultation*. They supply the most valuable, and, indeed, the only positive evidence of the disease.

Inspection. — Abnormal pulsation, and sometimes the existence of tumour, may be detected by inspection of the chest or abdomen; the signs observed being confirmed by those afforded by palpation.

Tactile signs.—The tactile signs of aneurysm, *impulse*, *fremitus*, and *remittent tension*, are contingent on the presence of a tumour. The impulse may be single or double. It is most frequently single, and is then always systolic in rhythm, coinciding approximately with the impulse of the heart. In character the systolic impulse is heaving and expansile; and it is diffused, in most instances equally, over the entire tumour. It is due to sudden expansion of the sac from active influx of blood during ventricular systole: hence, in those portions of the aorta which are close to the heart, it is synchronous with the apex-pulsation; but in the descending thoracic and abdominal aorta perceptibly post-systolic in time. The force of systolic impulse and the expansion of the sac will be directly as the contractile power of the left ventricle, and inversely as the deposit of coagulum within the sac. A second and more feeble impulse of diastolic rhythm is occasionally, but much less frequently, exhibited by an aortic aneurysm. This is the 'back-stroke,' or 'impulse of arrest' of authors. It coincides with the first period of ventricular diastole and the second sound of the heart, and is due to asynchronism of reaction between the aorta and the sac—that of the latter being notably later, owing to its defective elasticity. The consequence is a sudden arrest to the recoil of the sac by influx from the aorta. Diastolic impulse is therefore eminently characteristic of aneurysm.

Fremitus or thrill is of more frequent occurrence than diastolic impulse, and, when not communicated from the heart, no less distinctive of aneurysm. It accompanies the systolic impulse, and is due to the vibration of a thin sac from an eddy in the current of influx, produced either by a spiculated condition of the orifice, or by a pendent flake of fibrin.

Percussion-sound.—The intrinsic percussion-sound of aortic aneurysm is absolutely dull to the extent of the tumour. Posteriorly the dulness is not sufficiently distinguishable from that of the vertebral column and muscles to be of positive diagnostic value; whilst laterally and in front, when the tumour is not in actual contact with the walls of the thorax or abdomen, it is modified or masked by the intervention of the lung or the intestinal canal. Under any circumstances, dulness *per se* cannot afford positive evidence of aneurysm, inasmuch as it may be due to a tumour of any kind, solid or liquid, in the same situation; but, the presence of a tumour having been determined, the shifting of percussion-dulness from one point to another, or its cessation where it had been previously detected, would be in the highest degree suggestive of aneurysm.

Acoustic signs.—These are *tone* or *sound*, and *murmur*. *Sound* without murmur is of frequent occurrence in aneurysms of the arch, but comparatively rare in those of the descending thoracic and abdominal aorta. It is usually double, corresponding in time to the sounds of the heart, but exaggerated, the second aneurysmal sound being especially intensified. The first sound is occasionally 'splashing,' and both are not infrequently of a 'booming' quality,—characters no doubt due to the density, rigidity, and great capacity of the sac.

The *murmur* of aneurysm is most frequently single, systolic, and blowing; it is occasionally double (systolic and diastolic); and still more rarely single and diastolic. As to quality, the systolic murmur may be accompanied by a musical note, 'cooing,' or shrill, and audible over the whole or only a portion of the tumour. Lastly, it may be, and usually is, of a 'buzzing' character in cases of varicose aneurysm. The essential cause of the murmur of aneurysm consists in friction of the blood against the orifice, and the production of an eddy or a 'fluid vein' within the sac. A certain force of ventricular contraction is, however, likewise necessary. Hence the not infrequent coincidence of cessation of murmur with failure of the left ventricle for some time before death. A strongly contracting ventricle, a relatively small orifice, a capacious sac, and a liquid state of its contents, supply the most favourable conditions for the production of murmur. The orifice of entrance need not be absolutely narrow; a large fusiform aneurysm, even of the true kind, with rough walls, and containing liquid blood, may yield a loud systolic murmur, as the writers have frequently observed. A murmur may be absent in an aneurysm lined by thick laminæ of fibrin through which there is a smooth channel, or in a lateral aneurysm communicating by a small orifice with the vessel.

DIAGNOSIS.—The positive diagnosis of aneurysm of the aorta may be made from the existence of a tumour, forming a second centre of pulsation and of sound; the pulsation being systolic, expansile, and equally diffused over the tumour, accompanied by thrill, and succeeded by a minor pulsation of diastolic rhythm; whilst the sound, single or double, and accompanied or not by murmur, is always sharp and ringing, and occasionally of a 'booming' quality. The foregoing signs are rarely all associated in the same case. Various other groupings of rational symptoms and signs would be scarcely less conclusive as to the existence of aneurysm of the aorta. General systolic expansion, thrill, diastolic impulse, and exaggerated sound, at a point more or less distant from the heart, constitute the most positive signs of the disease.

The existence of aneurysm of the aorta may be inferred with greater or less confidence from certain symptoms and signs, according to their individual or correlative value. Even negative signs, if associated with others in themselves of minor significance, may be scarcely less conclusive than the most positive evidence would be. Thus, for example, suppressed respiration with undiminished percussion-resonance on the left side of the chest, dyspnœa, hæmoptysis, fixed pain in the back, and left intercostal neuralgia—the entrance of a foreign body into the left bronchus and the existence of cancer of the posterior mediastinum having been excluded—would be all but conclusive as to the existence of aneurysm. A foreign body in the bronchus might be diagnosed from the history of a misadventure in swallowing, followed immediately by dyspnœa, hæmoptysis, and the special signs of bronchial obstruction, which, in nine cases out of ten, would be on the right side; whilst the diagnosis of mediastinal cancer would rest upon evidence eminently suggestive, namely, the presence of cancerous enlargements in the neck and axilla, and of extreme dulness over the root of the lung, without corresponding pulsation or sound. Finally, aneurysm of the aorta may be, though it very rarely is, strictly latent in regard to both symptoms and signs.

PROGNOSIS, DURATION, AND TERMINATIONS. The prognosis of aortic aneurysm is in the highest degree unfavourable. Recovery is, however, under favourable circumstances and appropriate treatment, quite within the range of medicine. Numerous examples of the cure of aortic aneurysm, both thoracic and abdominal, have been lately recorded.

The duration of life, in connexion with aneurysm of the aorta, varies from ten days to eleven years (Hayden), but it may be much longer. The situation and relations of the aneurysm; its complications; the constitution of the sac, and the state of its contents; the previous health and present habits of the patient; and the advantages enjoyed in regard to rest and treatment—will all materially influence the prognosis, whether as to duration of life or prospect of recovery.

Death in aneurysm of the aorta may result from—(*a*) rupture of the sac; (*b*) exhaustion from pain, loss of sleep, or leakage of blood; (*c*) asphyxia; (*d*) syncope; (*e*) inanition; or (*f*) intercurrent disease. The foregoing represents the order of relative frequency of the several causes mentioned. Rupture of the sac is not, of necessity, immediately fatal. Hæmorrhage may be stayed, and life thus protracted for several days, by obstruction from the extravasated blood (itself arrested and coagulated in the surrounding tissues), or by its pressure upon the aorta on the proximal side of the sac. Rupture into one of the chambers of the heart, the pulmonary artery, either vena cava, or the innominate vein, the portal vein, or the biliary passages, is usually fatal within a very brief period; whilst rupture into one of the serous cavities in the absence of previous adhesion, into the trachea or bronchi, or into the alimentary or the spinal canal, is instantaneously fatal.

TREATMENT.—The treatment of aneurysm of the aorta is *palliative* and *curative*. Pain from nerve-pressure is most effectually relieved by hypodermic injections of morphine, one quarter to half a grain in solution, repeated and increased in quantity according to necessity; cocaine administered hypodermically may also be employed. The pain and oppression due to congestion of the sac and the surrounding structures is best treated by local or general abstraction of blood, or the use of an ice-bag over the tumour, combined with the use of cardiac and vascular depressants, especially iodide of potassium (20 to 30 grains every fourth hour), chloral hydrate (20 grains), veratrum viride, or aconite (5 to 10 minims of the tincture every third hour). Antipyrin (10 to 20 grains every third hour) has been found to give relief. Mechanical support by means of a well-constructed shield is likewise useful when the tumour projects externally. Fixed pain in the back, due to erosion of the vertebræ, is most effectually relieved by leeching, or by the application of a seton or issue in the vicinity of its seat.

The *curative* treatment of aneurysm of the aorta may be classified under the heads of—(*a*) compression of the artery, proximal or distal; (*b*) distal ligature; (*c*) absolute rest and regulated diet; (*d*) the use of medicinal agents promotive of coagulation within the sac; and (*e*) local measures—such as (1) the application of the galvanic current, the positive pole, carefully insulated, being introduced into the sac, the negative pole being placed on an indifferent part in its neighbourhood;

(2) the passage of fine iron wire, horsehair, or catgut into the sac, so as to cause coagulation. For the details of these several modes of treatment the reader is referred to the articles in this volume respectively entitled Aneurysm; Abdominal Aneurysm; and Thoracic Aneurysm.

Thomas Hayden. C. J. Nixon.

AORTIC VALVES, Diseases of.—*See* Heart, Valvular Diseases of.

APEPSIA (ἀ, priv.; and πέπτω, I digest). Indigestion. *See* Digestion, Disorders of.

APERIENTS (*aperio*, I open).—Medicines which produce a gentle action of the bowels. *See* Purgatives.

APHAGIA (ἀ, priv.; and φάγω, I eat).—Inability to swallow. *See* Deglutition, Disorders of.

APHASIA (ἀ, priv.; and φημὶ or φάω, I speak).—Synon.: Aphemia; Alalia; Fr. *Aphasie*; Ger. *Sprachlosigkeit.*

Description.—Aphasia is the name given to a defect of speech from cerebral disease. The patient is found to be unable to utter any proposition, though his occasional distinct pronunciation of some one or two words shows that his speechless condition is not due to a mere difficulty in the more mechanical act of articulation. Moreover, the patient's intelligent manner and gestures may plainly show that he understands what is said, and is capable of thinking, even though he is quite unable to give expression to his thoughts. This kind of powerlessness as regards speech is most frequently encountered in persons suffering from right hemiplegia, though it is occasionally met with in those who are paralysed on the left side, and at other times in persons who are not hemiplegic at all.

The aphasic condition is not always, as it ought to be, clearly distinguished from that of another group of cases which may be encountered in association with some amount of hemiplegia or independently, and to which the name *amnesia* is given. The essence of this latter defect lies in the fact that the patient's speech is defective because of his inability to recall the proper words for the expression of his thoughts or wishes; and he very frequently substitutes wrong words or names in the place of those he wishes to employ, as when speaking of his 'hat,' he calls it a 'brush;' or when seeking a 'pen,' he asks for a 'knife.' In a bad case of this kind the patient may be quite unable to arrange words into a sentence capable of conveying a definite meaning, so that his speech is rendered unintelligible. Where this species of defect exists there seems to be either a defective or an inco-ordinate action of one or other of those higher cerebral centres whose function it is to translate thought into the corresponding motor acts of speech, so that we get hesitation in the utterance of right words, or the substitution occasionally of entirely wrong words or even of a meaningless set of sounds. These amnesic or inco-ordinate defects were not at first recognised as being distinct in nature from those of an aphasic type, in which there is rather a loss than a misdirection of power in one or other of the higher centres whence the incitation to the motor acts of speech proceed. The two kinds of defects, indeed, not unfrequently coexist to some extent in the same individual.

When occurring in association with hemiplegia, aphasia varies much in intensity according to the degree of general mental impairment with which it may be combined. During the first week or ten days after the onset of such an attack the special defect may be scarcely recognisable, owing to the masking influence of the general mental impairment. But after a time such a patient may regain a considerable amount of general mental power. He may be left more or less hemiplegic, and may also present the aphasic defect to a marked degree. He readily comprehends everything that is said to him, and can often understand what he reads.

But at other times, though able fully to understand when read to, he does not seem to understand when he himself attempts to read—a disability now often spoken of as 'word-blindness.' He can, perhaps, play draughts or chess well, and by means of gestures and pantomime can make his wants and most of his wishes fairly well understood by those accustomed to interpret them. Yet he may only be able to articulate some one or two words, or else combinations of mere unmeaning sounds, such as 'poi, boi, bah,' 'sapon.' On rare occasions, under the influence of strong emotion, the patient may blurt out some simple expletive or short phrase, such as 'oh dear!' He cannot be made to repeat a word, or even the simplest vowel-sound, which he has just heard uttered. In a few cases the patient has seemed unable to understand what is said, as though from some difficulty in realising the meaning of words. Words may have to be uttered very slowly and repeated several times to such a patient, and even then they may fail to convey their meaning—a defect known as 'word-deafness.' Yet the language of gesture, appealing as it does to the sense of sight, may be at once understood.

The patient's power of writing is necessarily interfered with when aphasia, as is so often the case, co-exists with right hemiplegia. Many such patients, however, learn to write with the left hand to a variable extent. The variations as regards the power of writing are, in fact, almost as marked as the variations in power of speaking, though these two classes of defects by no means run parallel with one another in the same individual. The writer has known patients who were quite unable to express themselves in spoken words, or even utter a single articulate sound, write a good letter with no, or very few, mistakes (*aphemia*); on the other hand, the performance of an aphasic patient, without a copy before him, may be, and most commonly is, limited to writing his own name. At other times the patient shows an amnesic defect in writing, and writes much as an amnesic patient speaks. Still more rarely it is found that an aphasic patient is, though not from want of manual power, unable to write even a single letter (*agraphia*)—in attempting to do so he makes mere unmeaning strokes.

The disability spoken of above as 'aphemia' may be complete, and then the patient is absolutely speechless. But incomplete aphemia or aphemic defects exist in many degrees of completeness. These terms are now often applied to defects in the power of articulation—the mere mechanical part of speech—in which difficulties exist such as go with diseases in the bulb or the pons, or the slighter defects in utterance, constituting mere 'thickness of speech.' This kind of defect differs from (and may be easily distinguished from) aphasia, seeing that the subjects of it will always attempt at once to utter any word or simple sound, when they are bidden to do so. The term 'anarthria' has been used by some writers for what would be called bad aphemic defects—such, for instance, as are met with in bulbar diseases, where the articulatory motor centres are themselves the seat of lesion.

Aphasia occasionally supervenes, independently of paralysis or convulsions, in individuals who have been subjected to great excitement or prolonged overwork, when it may be due, perhaps, to mere functional derangements. In other cases it presents itself as a temporary condition, lasting only for a few hours or a few days, in a patient who has just had an attack of right-sided unilateral convulsions; or, lastly, as has already been indicated, it occurs in conjunction with a right-sided hemiplegia produced either by brain-softening or by cerebral hæmorrhage. Cases belonging to the latter category vary very much amongst themselves as regards the degree of co-existing hemiplegia. If the third left convolution alone is damaged by softening, the hemiplegic condition may be absent, or transient and incomplete — never, perhaps, affecting the leg appreciably. This condition is often induced by a small hæmorrhage, or by a patch of softening produced by an embolism of that branch of the middle cerebral artery which supplies the third frontal convolution; but where the hæmorrhage is larger, or where the main trunk of the middle cerebral artery is obliterated, either by an embolus or a thrombus, the aphasia, or aphasia with amnesia, is combined with much graver and more persistent hemiplegic symptoms.

Pathology.—The modern concentration of attention upon these defects of speech was started by the enunciation of Broca's views as to the dependence of the aphasic defects upon lesions in or about the third left frontal convolution. And all pathologists are now agreed as to the fact that such lesions are much more prone to give rise to aphasic symptoms than are corresponding lesions on the right side of the brain. It is commonly believed, moreover, that *amnesic* defects of speech are most commonly produced by superficial lesions of the left hemisphere, though by lesions situated farther back—that is, in the neighbourhood of the posterior extremity of the Sylvian fissure.

The third left frontal convolution is not now supposed, as Broca put it, to be the seat of any 'faculty of language,' though the anatomical investigations of Meynert and of Broadbent have shown that its relations with other convolutions are exceptionally complex. Whether certain higher 'motor' centres for speech are situated in this part of the brain, as is commonly believed, or whether such centres are rather, as the writer believes, kinæsthetic centres, it must at least be conceded that this convolution is intimately concerned with the physical expression given to thought in articulate speech.

We know that the left hemisphere is the one from which the volitional incitations proceed in the case of written language, and it is presumed that the same half of the brain also takes the lead in the production of articulate speech. It is, therefore, a point of much interest when we find that, in some of the exceptional cases in which aphasia has occurred in association with lesions on the right side of the brain and left hemiplegia, the individuals had been left-handed during life. Some of the other exceptional cases, however, have not admitted of this interpretation.

Different kinds of Word-memories.—For the proper understanding of these different defects of speech and writing many details are essential. There are four different kinds of word-memory—three essentially different types, but one of them existing in two forms, so as to make four varieties in all. These varieties of verbal memory are as follows: (1) Auditory memory — the memory of the *sounds* of words, that is, of the auditory impressions representative of different words; (2) Visual memory—the memory of the *visual appearances* (printed or written) of words, that is of the visual impressions corresponding with different words; (3) Kinæsthetic memory—(*a*) the memory of the different groups of sensory impressions resulting from the movements of the vocal organs during the utterance of words (impressions from muscles, mucous membranes, and skin)—these the writer has proposed to speak of as '*glosso-kinæsthetic*' impressions; (*b*) the memory of the different groups of sensory impressions emanating from the muscles, joints, and skin during the act of writing individual letters and words—these the writer has proposed to speak of as '*cheiro-kinæsthetic*' impressions.

The organic seat of each of these different kinds of word-memory is in relation with its own set of afferent fibres; and the several centres are also connected with one another by commissural fibres, so that the recollection of a word in one or other of these modes doubtless involves some amount of simultaneously revived activity in one or two of the other word-centres. The relative intensity (in the process of recollection of words for ordinary speech) of the memorial revival in each of these centres is probably subject to more or less marked variation in different individuals. In the majority of persons the revival of words in the auditory centre is the most potential process, and that of which such persons are most conscious. In a smaller percentage of persons the revival of words in the visual centre seems to be the most essential process. While in a very much smaller percentage it seems possible that revival in the kinæsthetic speech-centre may be the most conscious process occurring during the recollection of words.

Owing to the fact of the existence of this multiple memory of words, it happens that loss of speech by no means always, or often, implies the loss of the memory of words. Many a patient who cannot speak can yet revive his auditory or his visual memory of words, so as more or less perfectly to understand what he hears, or what he sees (in print or writing), or perhaps what he both hears and sees.

It is also of importance to be borne in mind that for ordinary persons (that is, those who are neither congenitally blind nor congenitally deaf) the four memories of words are mainly called into play in definite couples, namely, the auditory and the glosso-kinæsthetic revivals taking place in ordinary speech; and the visual and the cheiro-kinæsthetic revivals taking place during ordinary writing. So that in expressing oneself in spoken words the memories of such words are first principally revived in the auditory centre, and then the nerve-units thus called into activity rouse in immediate succession the corresponding glosso-kinæsthetic elements before the pronunciation of the word can be effected through the aid of the motor centres in the medulla. Similarly, when expressing our thoughts by writing, though the memories of words are probably first revived in the auditory word-centre, like memories are almost simultaneously revived (through the intervention of the audito-visual commissure) in related parts of the visual word-centre; and from this region stimuli must pass through corresponding cheiro-kinæsthetic elements, before the actual writing of the word can be effected through the instrumentality of motor centres in the cervical region of the cord.

There can be no doubt that the functional association existing between the auditory and the glosso-kinæsthetic centres is of the closest kind. But the bond of association between the auditory and the visual centres is no less intimate. These latter centres are often necessarily called into activity in immediately successive units of time. This happens, for instance, in two such common processes as reading aloud and writing from dictation.

In reading aloud the primarily excited visual word-centre must arouse (through the visuo-auditory word-commissure) related parts of the auditory word-centre, since this is the part which ordinarily calls the glosso-kinæsthetic centre into activity, and from it properly co-ordinated incitations issue to call into play the motor centres in the medulla.

Again, in writing from dictation, the sounds of words reach the auditory word-centre, and the activity thus aroused becomes transmitted (through the audito-visual commissure) to related parts of the visual word-centre, this being the part which usually arouses the cheiro-kinæsthetic centre into activity for the production of writing movements.

In deaf-mutes, in the congenitally blind, and also in certain cases of disease, as it would seem, the relations between the centres are rather those indicated by the dotted lines (*f e*) in fig. 5.

Concerning the Localisation of the different Word-centres.—Looking to the extremely important part that 'words,' either spoken, written, or printed, play in our intellectual life, and to the manner in which they are interwoven with all our thought-processes, it becomes highly probable that most important sections of the auditory and visual perceptive centres are devoted to the reception (and consequently to the revival in thought) of impressions of words; so that, for convenience of reference, we may speak of these sections as auditory and visual 'word-centres' respectively. Similarly, there must be kinæsthetic word-centres of two kinds—the one in relation with speech movements, and the other in relation with writing movements. It is possible that the parts of the general auditory and visual centres which are in relation with word-impressions may be as distinctly defined as are the analogous parts of the general kinæsthetic centres that are in relation with speech movements. Certain it is that there are some varieties of amnesia in which the part of the visual centre in relation with words seems to be specially at fault (causing 'word-blindness'); just as there are other cases in which the part of the auditory centre in relation with words is either wholly or partially inactive (causing 'word-deafness'), in each case without evident defect in other parts of the general auditory or visual word-centres.

In regard to the visual centre as a whole, it seems to be now established that it is more or less diffused through the occipital lobe. As to the localisation of the general auditory centre, there is some clinico-pathological evidence to show that the auditory word-centre may be in, or in the immediate neighbourhood of, the upper temporal convolution.

The situation of the two kinæsthetic word-centres can, however, be much more precisely localised. The writer holds the opinion that the so-called cortical 'motor centres' of Ferrier and others are really sensory centres of kinæsthetic type, by means of which movements are guided (*see* KINÆSTHESIS). That being so, Broca's region, or Ferrier's centre for the movements of the mouth and tongue (viz. the posterior part of the third frontal and the inferior part of the anterior ascending frontal convolution) is, in reality, the part of the brain which we have been alluding to as the glosso-kinæsthetic word-centre. The situation of the cheiro-kinæsthetic word-centre cannot be localised as yet with as much confidence, though the tendency is to follow Exner, who believes it to be situated in the posterior part of the second frontal convolution.

It must be supposed, therefore, that the auditory and the visual word-centres are situated, the one not far away from, and the other actually within, some part of the cortex of the occipital lobe, and that they are connected together by a double set of commissural fibres (fig. 5, *a*, *b*). We must also suppose that two other sets of commissural fibres exist which are of much importance in regard to speech and writing, viz., one set (*c*) through which the auditory word-centre acts upon the glosso-kinæsthetic centre, for the production of articulate speech; and the other (*d*) by means of which the visual word-centre acts upon the cheiro-kinæsthetic centre, for the production of writing.

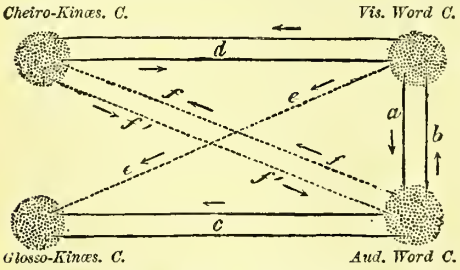

FIG. 5. Diagram showing the commissural connections between the different word-centres.

a. The visuo-auditory commissure.
b. The audito-visual commissure.
c. The audito-kinæsthetic commissure.
d. The visuo-kinæsthetic commissure.

Thus, for speech we have the combined auditory and glosso-kinæsthetic word-centres, acting from the cortex through internuncial fibres, upon motor centres in the medulla; and for writing we have combined visual and cheiro-kinæsthetic word-centres, acting from the cortex through internuncial fibres, upon motor centres in the cervical region of the cord. In the study of speech-defects generally it is, therefore, needful to consider the effects of lesions: (1) in the different kinds of word-centres; (2) in the different commissures by means of which the centres are connected; (3) in certain internuncial fibres; and (4) in certain motor centres.

Defects of Speech from Lesions in Word-Centres.—According to the writer's views it is not at all needful, as many authorities have thought, to postulate the existence of a separate 'centre for conceptions or ideas.' The supposed theoretical necessity for assuming the existence of some such centre may in most cases be obviated by a fuller recognition of the different degrees of functional excitability that may exist in the auditory and the visual word-centres respectively. It should, in fact, be constantly borne in mind by those who study these defects of speech that each perceptive centre is capable of being called into activity in three modes: (*a*) by 'voluntary' recall of past impressions, as in an act of recollection; (*b*) by 'association,' that is by impulses communicated from another centre during some act of perception or during some thought-process; (*c*) by means of external impressions. Now the excitability of these centres is liable to vary much—as a result of advanced age, or of different general or local morbid states. The molecular mobility may be so much lowered that they are only capable of responding to powerful stimuli; in such cases either 'volitional' recall alone, or 'associational' recall as well, may be impossible or more or less difficult, responses occurring only to external impressions—that is, the patients are only able to repeat words pronounced, or to copy words written before them.

The effects of lesions of the different word-centres are as follows: (1) A lesion of the glosso-kinæsthetic centre produces simple aphasia; whilst (2) one of the cheiro-kinæsthetic centre produces simple agraphia. In neither condition is the power of thought very appreciably interfered with. These are commonly supposed to be motor defects, but this the writer believes to be an erroneous interpretation—since they are defects due to the loss of certain sensorial aptitudes (of the kinæsthetic order) just as much as are the other forms of aphasia now about to be mentioned, the existence of which were first pointed out and explained by the writer in

1869, though they were subsequently more prominently explained in 1874 by Wernicke under the name of 'sensory aphasias.' One of these has been known as 'word-deafness' and the other as 'word-blindness.' But defects in the activity of the auditory and of the visual word-centres respectively give rise to varied and complicated results, which can only be very inadequately summarised by these phrases. Thus under the head of (3) lesions of the auditory word-centre, we must refer to totally different defects according to the degree of functional degradation of the centre: (*a*) slight auditory amnesia from functional defect of the centre, leading to impaired spontaneous speech, owing to forgetfulness of names or nouns; (*b*) profound auditory amnesia, in which, from similar causes, both voluntary and associational speech are greatly impaired, though imitative speech is retained, and the almost speechless patient may be able to read aloud correctly and fluently; (*c*) word-deafness and aphasia owing to a destructive lesion of the auditory word-centre, in which the patient is not only unable to comprehend speech, but is himself speechless, and may also be unable to write spontaneously. Lesions of (4) the visual word-centre, whether functional or structural, reveal themselves in less varied modes; when severe they would result in the production of word-blindness together with agraphia.

Defects of Speech from Lesions of the Commissures between Word-centres.—It seems to the writer better to reserve the word 'commissure' as an appellation for the fibres that connect centres of the like kind, that is, either sensory centres or motor centres; and to name 'internuncial' the fibres which connect sensory with motor centres.

As already stated, double commissures exist between the auditory and the visual word-centres (fig. 5, *a*, *b*) which are habitually called into play in certain mental operations, so that their destruction leads to very definite defects. Thus, in naming objects at sight, or in reading aloud, stimuli have to pass from the visual to the auditory word-centre (by the visuo-auditory commissure) before the naming or the reading aloud can occur. Again, in writing from dictation, and probably also in writing any spontaneous effusion, stimuli require to pass between these two centres in an opposite direction, namely, from the auditory to the visual centre, and through a different set of fibres (the audito-visual commissure). In 1880 the writer published (*The Brain as an Organ of Mind*, p. 640) some details concerning a man (who has ever since been under observation from time to time) who suffers from a lesion destroying the commissures in question. This man understands perfectly all that is said to him and all that he reads, yet he cannot read aloud a single word or even name a single letter, though immediately that he hears the word or letter pronounced he can repeat it at once. Again, he cannot write a single word, or even letter, from dictation, though he can at once, with his left hand, proceed to copy any such word or letter that may have been written for him on a sheet of paper. Cases have been recorded also in which the separate halves of the commissure between the auditory and the visual word-centres have been damaged; so that reading from dictation or naming at sight have been interfered with and not writing from dictation, or *vice versâ.*

The other commissures whose lesions have to be considered are those (fig. 5, *c*, *d*) connecting the auditory with the glosso-kinæsthetic, and the visual with the cheiro-kinæsthetic word-centres. Defects in the course of these commissures are of interest, more especially from the point of view of a regional diagnosis. The writer some years ago pointed out, for instance, that a lesion of any part of the audito-kinæsthetic commissure (fig. 5, *c*) should produce an aphasia indistinguishable from that which would be produced by damage to Broca's convolution, that is, to the glosso-kinæsthetic centre itself. This is, of course, a very important point, since it shows that it is an error to suppose that typical aphasia can only be caused by a lesion in Broca's region. A precisely similar result should also be produced by complete destruction of the audito-kinæsthetic commissure, in any part of its course between that region and the neighbourhood of the occipital lobe where the auditory word-centre is situated. If the latter centre itself be damaged, as before stated, we then get the aphasia complicated with word-deafness, and thus have the means of arriving at an accurate regional diagnosis. Once clear of the centre, however, a lesion involving any part of the audito-kinæsthetic centre should produce a typical aphasia absolutely indistinguishable clinically from that resulting from a lesion in Broca's region itself. This explains the occurrence of aphasia in associa-

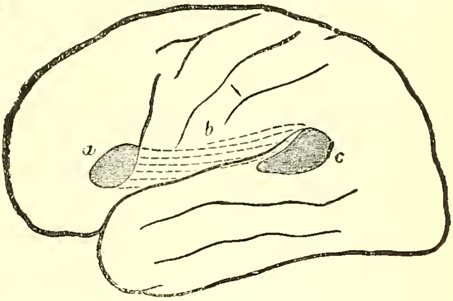

FIG. 6.—Diagram showing the possible location of an aphasia-producing lesion, either in the glosso-kinæsthetic centre (*a*), in the audito-kinæsthetic commissure (*b*), or, in association with word-deafness, in the auditory word-centre (*c*).

tion with lesions in the island of Reil, and other sites nearer the posterior extremity of the Sylvian fissure (see *Brit. Med. Jour.*, Nov. 5, 1887, p. 986).

This point, like the question of the existence and interpretation of aphemia, will be found to be a touchstone for testing the truth of the doctrines here set forth concerning the pathogenesis of speech-defects, as compared with those of Stricker and of Hughlings Jackson. According to their views, the commissural fibres now referred to pass between the auditory and a true 'motor' centre for articulation. According to Stricker (*Le Langage et la Musique*, 1885, p. 73), a damage occurring in the course of these fibres would cause, not aphasia but word-deafness. His view being that words are realised mainly by memorial revival in motor cortical centres, in the case assumed there would be word-deafness because stimuli could not pass from the auditory to the assumed motor centres in which the essential part of the apperceptive process is carried on. It seems clear also that these doctrines necessitate the view that an isolated lesion in Broca's region only should also cause word-deafness as well as aphasia. This, however, is certainly not the case—a fact which is itself sufficient to negative the truth of the views of Hughlings Jackson and of Stricker.

Damage to any part of the visuo-kinæsthetic commissure (fig. 5, *d*) would also be capable of producing agraphia of just as complete and typical a kind as if the lesion had been in the cheiro-kinæsthetic centre itself.

Defects of Speech from Lesions of Internuncial Fibres.—We have here to do with a kind of defect known as aphemia. This is a speech-defect, and there is no analogous defect of writing, except that which is occasioned by actual paralysis of the right hand. In complete aphemia there is absolute loss of articulate speech without any mental impairment, and with the power of communicating the thoughts by writing preserved absolutely intact. An excellent example has been recorded by the writer in the *Brit. Med. Jour.*, Nov. 5, 1887.

Such a condition is produced when the glosso-kinæsthetic centre is itself uninjured, but where the whole of the internuncial fibres emanating from it and proceeding to the true motor articulatory centres in the bulb are damaged in some part of their course —whether just beneath the cortical centre, in the internal capsule, in the peduncle, or in the pons. Sometimes the defect may be of a functional rather than of a structural type, constituting Charcot's 'hysterical mutism in the male.'

Incomplete aphemias, however, exist of all degrees of severity, and they are about the commonest of all speech-defects occurring in association with hemiplegia. They are due to partial damage to the group of internuncial fibres above referred to, and are represented by defects of articulation, varying from almost complete unintelligibility to the mere blurred utterance or thickness of speech which is so common.

Aphemia is clearly not a sensory defect—it is not a form of amnesia—because the subjects of it can revive words in all possible modes, and are, therefore, able to think and express their thoughts with an unimpaired freedom by writing. If the aphemia be in any way incomplete, moreover, such a case can be easily discriminated from a case of aphasia by the fact that the aphemic patient will always at once make an attempt, when bidden, to pronounce some simple word or syllable (however poor the attempt may be), while the typical aphasic patient is unable to make any such attempt—he will not try even to repeat the simplest vowel-sound.

Defects of Speech due to Lesions in the Bulbar Articulatory Centres. — In these cases, as where the lesions occur in the internuncial fibres, all the centres in which the memory of words can be revived are intact. There is consequently nothing whatever to interfere with the flow of thought, and in incomplete cases nothing to prevent attempts at articulation being made. These two classes of cases are indeed less separable clinically than they are from a theoretical or scientific point of view.

It would be well to reserve the term 'anarthria,' as introduced by Kussmaul, for the defects of speech caused by morbid states of the bulbar articulatory nuclei—with the full understanding, however, that aphemia and anarthria will often be indistinguishable from one another by their own intrinsic characters, though they will generally be quite capable of being diagnosed from one another by taking into consideration the mode of onset and the particular grouping of other attendant signs.

DIAGNOSIS.—The means of distinguishing the different aphasic and amnesic speech-defects from one another has already been fully enough set forth in the preceding sections. The diagnosis of the exact nature of the defect is often exceedingly difficult, unless the patient be thoroughly examined in a systematic manner, and in accordance with some definite plan. Elsewhere (*Paralyses; Cerebral, Bulbar, and Spinal*, 1886, p. 125) the writer has given such a 'Schema for the Examination of Aphasic and Amnesic Persons,' which has been used with success for many years. The other side of the question, viz., the pathological diagnosis, must be made in accordance with the rules generally applicable to this part of the diagnostic problem in cases of brain-disease.

TREATMENT.—Where aphasia occurs after excitement or overwork, without paralysis, it is a warning of much importance, since it may be the precursor of much graver symptoms. Under such circumstances the patient requires an absolute cessation from work for a time, and most careful watching. Stimulants may need to be diminished; and bromide of potassium, with sumbul and other sedative remedies, should be administered. Where aphasia is a temporary condition in association with right-sided convulsions, or where it is lasting and co-exists with right-sided paralysis, the treatment of the aphasic condition becomes merged in that of the associated convulsive tendency or paralytic condition, since, as a rule, an amelioration takes place in the patient's power of speaking coincidentally with his improvement in other respects. This, however, is not always the case where aphasia has co-existed with a partial hemiplegic condition: the paralysis may be recovered from, whilst the aphasic defect may remain more or less as it was. Where this is the case, an attempt should be made to teach the patient to speak again, especially if the defect be of the aphemic type. Such efforts have occasionally been crowned with success (see *Trans. of Clin. Soc.*, vol. iii. p. 92, and *Brit. Med. Journ.*, Nov. 5, 1887, p. 988), but much judgment and untiring patience have to be called into play in order to obtain satisfactory results.

H. Charlton Bastian.

APHEMIA (ἀ, neg.; and φημὶ, I speak). A term differently applied by different writers, but commonly understood to be a designation for certain articulatory defects (*see* Anarthria) dependent upon injury, direct or indirect, to the internuncial fibres connecting Broca's convolution with the motor centres of the bulb. Where the aphemia is incomplete the nature of the defect is generally obvious; where it is complete the patient is absolutely speechless, and is apt loosely to be described as aphasic, though the fact that he can express himself freely by writing shows that this is not a correct designation of his condition. *See* Aphasia.

APHONIA (ἀ, priv.; and φωνὴ, the voice). Absence of voice, that is, of intonated utterance. *See* Voice, Disorders of.

APHRODISIACS (Ἀφροδίτη, Venus).—Definition.—Medicines which increase the sexual appetite and power.

Enumeration.—The direct aphrodisiacs include: Nux Vomica and Strychnine, Phosphorus, Cantharides; Urtication and Flagellation; Cannabis Indica, Damiana, Opium, and Alcohol in small doses. Iron and bitter tonics; meat diet; warm clothing, especially around the hips and loins; and abstinence from severe mental and bodily work, act as indirect aphrodisiacs.

Action.—Aphrodisiacs may act by increasing the excitability of the nerves passing to or from the genital organs, or of the genital centre in the spinal cord (*see* Anaphrodisiacs), as, for example, strychnine, nux vomica, and probably phosphorus; by causing irritation of the nerves of the genital or urinary organs or of adjoining parts, as cantharides and urtication; or by stimulating the brain, as Indian hemp or small doses of opium. Alcohol in large doses has a double action, increasing the sexual desire by stimulating the brain, while lessening the power of erection, probably by weakening the nervous mechanism through which erection is produced. As the sexual passion becomes diminished when the nervous system is weakened with the rest of the body, and increases with returning strength, iron with bitter tonics, and generous diet act indirectly as aphrodisiacs.

Uses.—When the sexual functions are abnormally depressed, strychnine and phosphorus are the most generally useful of the direct aphrodisiacs. Cantharides, although sometimes valuable, must be employed with caution.

T. Lauder Brunton.

APHTHÆ (ἅπτω, I inflame).—Synon.: Aphthous Stomatitis; Fr. *Muguet*; Ger. *Fasch.*

Definition.—A form of catarrh of the buccal mucosa, characterised by the appearance of one or more patches (*aphthæ*) possessing a peculiar structure.

Anatomical Characters.—Aphthæ have at first the appearance of vesicles; but microscopical sections show that they are due to elevation of the epithelium by a solid, fibrinous exudation, over which the epithelium usually dies, soon separating with the fibrinous flake. By the time this is effected the mucosa is again, as a rule, thinly covered by epithelium, so that a true ulcer is never present; but slight suppuration may be established, with the destruction of the superficial layer of the mucosa.

Symptoms, Course, and Duration.—Aphthæ occur chiefly in children during the first dentition, upon any part of the buccal mucosa—most frequently inside the lower lip and on the tip of the tongue. At first they look like small vesicles, but after a few hours they resemble ulcers with adherent grey or yellowish sloughs, each being surrounded by a ring of injection. The patches vary in size from that of a lentil downwards; they are single or multiple; grouped or scattered; two or three may coalesce, but the patches never reach a large size. Aphthæ cause slight pain, and are specially sensitive to substances like salt or sugar. Dyspeptic troubles are usually present, and the breath is often foul.

Each aphtha runs its course in three or four days, and when multiple the patches come out in a crop. This may be succeeded by other crops, so that all stages of the lesion may be present at one time. The trouble may thus continue for weeks. In other cases patients are liable to crops of aphthæ at varying and sometimes long intervals.

Diagnosis.—Aphthæ have chiefly been mistaken for patches of thrush. Absence of the red areola, and presence of the characteristic fungus, will distinguish thrush even when no history or statement of symptoms can be obtained.

Treatment.—The occasional application of a little powdered borax to the aphthæ causes their speedy healing. In prolonged cases, the health in general, and stomach and intestines in particular, must be attended to.

Stanley Boyd.

APHTHOUS.—A term applied to diseases in which aphthæ are present.

APLASTIC.—(ἀ, priv.; and πλάσσω, I mould).—Incapable of being organised or of forming tissues; generally applied to inflammatory exudation.

APNEUMATOSIS (ἀ, priv., and πνεῦμα, respiration).—A synonym for atelectasis. *See* Atelectasis.

APNŒA (ἀ, priv.; and πνέω, I breathe).—Apnœa, literally signifying breathlessness, is used by some medical writers as synonymous with asphyxia, the condition which supervenes on suspension or obstruction of the respiratory function. *See* Asphyxia.

By physiologists, and with more correctness, the term is employed to signify the cessation of respiratory movements which is brought about by hyperoxygenation of the blood; as when an animal is made to inhale oxygen, or to breathe more rapidly than the needs of the economy require.

APOLLINARIS, Waters of.—Acidulous alkaline table-waters. *See* Mineral Waters.

APOPLEXY.—Definition.—The word *apoplexy* means, by its etymology, a *striking from* (ἀπὸ, from, and πλῆξις, a striking), and was at first and is still chiefly used to signify sudden abolition of consciousness and power of motion, which, in common English, is also called *a stroke*. The idea fossilised in the term is that of an unseen actor, and brings to our lips unconsciously the thoughts of an age that is much less distant in the time that is measured by centuries, than in that which is estimated by the cycles of thought.

Cerebral hæmorrhage is the most frequent cause of apoplexy; thence 'hæmorrhage into the brain' and 'apoplexy' came to be used as synonymous expressions. Subsequently the effusion of blood itself was spoken of as *the apoplexy*, the word being used to designate the pathological condition causing the symptoms which it at first epitomised. Ultimately it was applied to such spontaneous hæmorrhage elsewhere; and thus extravasations into the substance of the lung, the spleen, or the retina were, and still are, termed pulmonary, splenic, or retinal 'apoplexies.' It would be difficult to find a more striking instance of the looseness of the process of nomenclature, or of the strange way in which precision in words lagged behind the process of pathological discovery.

The term *cerebral apoplexy* is sometimes used to particularise hæmorrhage into the brain, but it is more commonly employed to denote an apoplectic condition depending on any cerebral lesion, and in that sense it will be here employed.

W. R. Gowers.

APOPLEXY, CEREBRAL.—Synon.: a 'stroke'; Fr. *Apoplexie;* Ger. *Schlag.*

Definition.—Loss of consciousness, of sensation, and of voluntary motion, coming on more or less suddenly, and due to a morbid state of the brain.

The condition of *coma* is termed 'apoplectic' when of sudden or rapid onset. Loss of consciousness may be due to other causes acting directly on the brain, such as defective or excessive supply, or altered condition of blood; but it is customary to include among the forms of *apoplexy* that only which is due to cerebral congestion, and to consider as *apoplectic states* those only which result from distinct toxæmia. Unconsciousness resulting from acute anæmia of the brain, or such as succeeds an epileptic fit, is not termed apoplectic. The term has, of necessity, become restricted, as increasing knowledge has explained the nature of many conditions previously confounded with apoplexy. It should be further observed that the term has always been restricted to such conditions as occur without conspicuous external cause. The same state when due to an injury, is not called by the name which is employed if there is no injury. The explanation of the inconsistency is to be found in the idea that is to be traced alike in the native and the foreign word. The 'stroke' determines the designation when the agent is unseen. It is to the conception of an unseen striker that the word is due.

The essential cause of apoplexy is a sudden cerebral lesion, occurring without external injury. The sudden abolition of function seldom occurs except at the onset of a positive and permanent damage, and a sudden lesion cannot occur except as a result of an alteration in the physical conditions of the circulation, no other element in the brain being capable of thus suddenly producing a distinct lesion. The great cause of apoplexy is the rupture of a vessel, and hence the 'stroke' became so confused with the mechanism that the term became synonymous with a spontaneous hæmorrhage in any organ. The same state may, however, be caused by obstruction of a vessel by thrombosis or embolism. Profound coma is rarely due to any other spontaneous cerebral lesion. A very small hæmorrhage may cause apoplexy.

Apoplectic symptoms may, however, occur without obvious lesion of the brain. The coma which is associated with congestion of the head, is sometimes termed 'congestive apoplexy,' and that which occurs in the absence of any recognisable cause, has been called 'simple apoplexy.'

PATHOLOGY.—In all these cases the apoplexy is in relation chiefly to the extent and suddenness of the lesion, and the intensity of the damage. Roughly speaking, its occurrence may be said to depend on the suddenness, together with the intensity, of the cerebral mischief; its degree on the extent of the same. But the occurrence of apoplexy depends sometimes on the size of the lesion; and the degree varies not only directly with the extent of the mischief, but with the extent of brain-tissue which is exposed indirectly to the irritative influence of the primary lesion. Hence position of lesion has an influence in determining the apoplectic symptoms. For these several reasons apoplexy is especially profound when the hæmorrhage affects both hemispheres, either by simultaneous extravasation on each side, or as the result of hæmorrhage into the lateral ventricles.

The precise condition on which the essential element in apoplexy—the arrest of all manifestation of brain function—is immediately dependent has been a matter of much dispute. It was formerly ascribed to the pressure exerted by the clot on the rest of the brain, either influencing directly the cerebral tissue, or pressing on and emptying its capillaries (Niemeyer). That such pressure is exerted by a large hæmorrhage is unquestionable. The convolutions on the side of the extravasation are flattened, and the falx is bulged to the opposite side. It cannot be doubted that the intensity of the apoplexy in these cases is due in part to this cause. But this will not explain the occurrence of the symptom in small hæmorrhages, by which no general pressure is exerted, or not more than is at once relieved by the displacement of the mobile fluid which surrounds the vessels. It will not explain symptoms in laceration of the brain, nor the instant loss of consciousness at the very onset of a severe hæmorrhage, in which, as Jaccoud insists, it should, if merely due to pressure, be a late rather than an early symptom. There can be little doubt from these considerations, and from the cases in which there is no recognisable brain-lesion, that what is called shock is an important element in the causation of apoplexy. Thus in cerebral hæmorrhage the apoplectic symptoms are due in part to the influence on the rest of the brain of the irritation of the nerve-elements by laceration. A hæmorrhage, for instance, stops for a few hours all reflex action by the irritative inhibition downwards, and it stops also the cerebral action by the same process acting upwards. We can thus understand why vascular occlusion causes a slighter degree of apoplexy, since the immediate irritation of the local anæmia is less than that of laceration; and also why lesions of the pons produce, as they do, such deep and long-continued coma, since the irritated fibres are connected with a large part of the cerebrum, and thus influence it indirectly.

Simple apoplexy was a term given by Abercrombie to the cases, once thought to be frequent, in which apoplexy occurs without recognisable brain-mischief or blood-poisoning. Some of these cases were probably instances of uræmic poisoning, and others may have been due to undiscovered and extensive embolism, causing death before there was time for softening to occur. But cases are not infrequent to which neither of these explanations applies: in which death occurs in an apoplectiform attack, all the organs are found healthy, and the brain only exhibits, in common with the other organs, that passive congestion which results from an asphyxial mode of death. The nature of these cases is still mysterious, but they may be grouped with those in which fatal coma follows an epileptic attack, and is apparently due to the brain-shock produced.

Serous apoplexy is a term sometimes applied to cases of fatal apoplexy in which no lesion is discoverable except excess of serum on the surface of the brain. It is now understood that such serous effusion is associated merely with senile atrophy of the brain, and that the name, as a pathological designation, is no more than a refuge for a destitute diagnosis. There is no reason for associating its presence with the apoplectic symptoms. The cases described under this term were probably instances of uræmia, or of 'simple apoplexy' in old persons with atrophied brains.

SYMPTOMS.—Apoplexy is itself a symptom, and can only claim to be treated as a disease on account of the frequency with which it presents itself as the prominent element in a patient's state. The striking feature of apoplexy is loss of consciousness without obvious failure of the heart's action. The onset is often instantaneous, so that the sufferer falls to the ground. The face may be flushed or pale—it is rarely very pale. The heart and arteries vary in their state according to the cause; at first the pulse is often feeble from shock, even in cases in which it soon becomes full and tense. Respiration continues, but is laboured and stertorous. The limbs are motionless. In severe cases no reflex action can at first be excited. The pupils may be dilated, contracted, or unchanged: in profound coma they are usually dilated; and they often vary in size spontaneously, being sluggish in their action to light. The patient can usually swallow, although often with difficulty. The sphincters permit the escape of urine and fæces, or the urine may be retained. In a case of moderate severity the reflex action soon returns, the conjunctivæ become sensitive, the patient can be roused to exhibit some sign of consciousness, and he shows returning power of motion. At first there is merely a half-purposive withdrawal of a limb when it is pinched or pricked. Afterwards more prolonged and voluntary movements are produced: he opens his eyes when spoken to, and tries, when told to do so, to protrude his tongue. On the other hand, the apoplexy may continue or may deepen in intensity; the patient dying at the end of a few hours or a few days. Death rarely occurs in a shorter time than two or three hours. In very rare instances an extensive hæmorrhage into the pons or medulla, or an effusion into the fourth ventricle, may stop the respiration and kill the patient in a few minutes.

It is not often, however, that there is this simple loss of cerebral function, uniformly distributed, and gradually deepening or passing away. Much more commonly the symptoms of a local cerebral lesion are added to those of apoplexy. Frequently such symptoms precede the loss of consciousness—unilateral weakness, deviation of the mouth, convulsion. These may be recognised during the attack. The limbs on the one side exhibit more complete muscular relaxation than those on the other; they fall more helplessly when raised; or there is unilateral rigidity or clonic spasm, unvaried in its seat. Or inequality of pupils may be observed, or rotation of the head and conjugate deviation of the eyes. As a patient recovers, these local symptoms become more and more distinct, the tongue deviates on protrusion, speech and swallowing are difficult, or the patient may have lost the use of language.

In *ingravescent* apoplexy the commencement of the cerebral mischief is marked by symptoms of general shock, without any, or with merely transient, loss of consciousness. There is commonly pain in the head, and there may be other localising symptoms. After some hours, during which the patient may continue his occupation, coma gradually comes on and deepens into death. This form of apoplexy, first described by Abercrombie, is usually due to a slowly increasing cerebral hæmorrhage.

The temperature in cerebral apoplexy is at first lowered in most cases, but usually the fall is small, and is succeeded, after twelve to twenty-four hours, by a rise. In some cases there is a considerable rise within the first six hours, and the temperature then commonly continues to rise, reaching 104° or 106° Fah., and even higher. Such a symptom is a precursor of death.

Diagnosis.—The first diagnostic problem is whether the patient's state comes under the general name of apoplexy; or is one of the morbid conditions in which there is a loss of consciousness, similar in general characters to apoplexy, but due to one of the causes excluded in the definition given above. From the unconsciousness due to cardiac *syncope*, apoplexy is easily distinguished. In the former the heart's action fails, the pulse is weak and imperceptible, the face is very pale, the respiration is sighing and irregular, reflex action is rarely abolished, and the sphincters are seldom relaxed.

From the several forms of *toxæmia* the diagnosis is often easy, sometimes extremely difficult. It is easy when, on the one hand, the symptoms of apoplexy are preceded or accompanied by those of a local cerebral lesion; or when, on the other hand, the direct or circumstantial evidence of poisoning is clear, or the symptoms of toxæmia unmistakable. Where there are no local symptoms, and where no guiding history is to be obtained, the diagnosis is difficult, but a correct opinion may commonly be formed by an attentive comparison of the symptoms present.

There may be, as just observed, indirect evidence of toxæmia: the breath may smell of opium or alcohol; the urine may contain albumin. But albuminuria or a smell of spirit may mislead. Cerebral hæmorrhage often occurs after drinking; spirit is constantly given to a person in a fit. A smell of spirit must therefore only be allowed weight in the absence of any evidence of cerebral mischief. So, too, albumin is always present in the urine in uræmia, but it is also very frequently present in cases of cerebral hæmorrhage. Alone, this evidence of Bright's disease is of little value, except there be general œdema and the patient be young; then uræmia is more probable than vascular degeneration and cerebral hæmorrhage. The urine should always be examined microscopically with reference to structural changes in the kidneys. But with other symptoms which indicate uræmic poisoning, albuminuria is conclusive.

The age of the patient should be considered. Late life is in favour of brain-disease. The history of a fall or blow on the head adds weight to other symptoms of cerebral mischief.

The character of the coma will sometimes guide us. In uræmia, and commonly in alcoholism, it is less profound than in cerebral mischief, so that the patient can readily be roused. In apoplexy, in opium-poisoning, and in the most intense form of alcoholic poisoning, the coma may be profound. On the other hand, in cerebral hæmorrhage the patient may sometimes be roused to answer questions. Violent struggling is strongly in favour of drink.

The mode of onset of the coma is important. In apoplexy it is sudden; in uræmia it is slow. The uræmic patient becomes first drowsy, then comatose. But with convulsions uræmic coma may come on suddenly. The onset of the coma of opium- and alcohol-poisoning is also slow. Ingravescent apoplexy is of deliberate onset, but a profound degree of coma is quickly reached.

General convulsions at the onset exclude drunkenness, and usually opium-poisoning, while they favour the probability of uræmia, especially if they are followed by rigidity that changes its seat. When uræmic convulsions begin locally, the place at which they begin often varies. Cerebral mischief sometimes commences with a convulsion, but the convulsion is then commonly unilateral, at least in onset, and the preponderant affection of one side at a time is indicated by the deviation of the head. It is seldom that well-marked deviation of the head and eyes occurs, first to one side and then to the other, as the fit progresses, unless there is an organic lesion of the brain, and one-sided symptoms are almost always to be recognised afterwards. Rigidity of limbs or local muscular twitching during the coma is, if constant in seat, in favour of cerebral mischief; if variable in position, it is in favour of uræmia (Reynolds). In diabetic coma, the odour of the breath, and the result of an examination of the urine (never to be omitted) will prevent mistake, even in the absence of a history of diabetes. But the absence of local cerebral symptoms must be carefully noted, since the presence of diabetes does not exclude a cerebral lesion. Post-epileptic coma is of course preceded by a convulsion, and should be borne in mind.

The state of the pupils alone is of little importance. Great contraction occurs in and suggests opium-poisoning, but it is present in hæmorrhage into the pons Varolii. The pupils may be either normal or dilated in uræmia, in alcoholic or in belladonna-poisoning, and in apoplexy. Inequality of pupils, a unilateral symptom, points to brain-mischief. The retina should be examined, since the presence of albuminuric retinitis points, in the absence of the signs of a localised cerebral lesion, strongly to uræmia.

Lastly, the temperature should be noted. In uræmia there is persistent uniform depression; in cerebral lesions the initial depression is succeeded by a rise to a point above the normal.

The second problem in diagnosis is the precise cause of the apoplexy, the existence of which has been ascertained by the considerations just reviewed. This element, however, will be described more fully under the heads of the chief lesions that produce the state—cerebral congestion, hæmorrhage, and softening. In may be here pointed out that slight and transient apoplexy, without local symptoms, with flushed face, and coming on during effort, points to cerebral congestion; slight and transient apoplexy with marked local symptoms points to softening; early and profound loss of consciousness to cerebral hæmorrhage. Post-epileptic coma may be distinguished by the history of epileptic attacks; or, if this be not forthcoming, it may be suspected if symptoms of a local cerebral lesion or indications of toxæmia are absent, if the patient be under 40, and exhibits indications of speedy recovery, and also if he has bitten his tongue and passed urine. 'Simple apoplexy' cannot be diagnosed during life, since freedom from the symptoms of a local lesion does not afford ground for inferring that there is no such lesion.

Prognosis.—The prognosis in cerebral apoplexy depends in part upon the intensity of the attack. As long as unconsciousness is complete, and reflex action abolished, the patient is in danger of speedy death. The longer the apoplectic condition lasts without improvement, the less prospect is there of recovery. Persistent depression of temperature, or a rise of several degrees above the normal either with or without an initial fall, are both of grave significance; such cases rarely recover (Charcot, Bourneville).

The nature, extent, and position of the cerebral lesion, when they can be inferred, furnish other prognostic indications. In hæmorrhage the prognosis is more serious than in softening. A sudden occurrence or increase of apoplectic symptoms, a few hours or days after a slighter attack, is always grave, indicating a fresh extravasation. If such apoplectic symptoms become profound and uniform, the prognosis is fatal, rupture into the ventricles or on the surface of the brain having probably occurred. If the localising symptoms point to a lesion of the medulla or pons, the prognosis is almost as unfavourable. Early return of consciousness and slight alteration in temperature are favourable signs. Previous cerebral disease renders the prognosis worse. Lastly, the prognosis must be influenced unfavourably by any impairment of the organic functions of circulation and respiration, whether independent of or due to the cerebral lesion. Previous alcoholism, from its effect on the nutrition of all tissues, is especially serious.

Treatment.—The treatment of cerebral apoplexy must be guided by the indications of its cause. Where none can be obtained, it should be treated by a system that is a compromise. The chief causes are hæmorrhage and thrombotic softening of the brain. Embolism seldom causes pronounced apoplexy. The measures therefore must be such as are suitable to both states, those being excluded which, while they would do good in one, would do harm in the other. But such a compromise is seldom needed. Diagnostic indications can usually be traced with clearness, and as a rule also several coincide distinctly in this direction, whilst those that do not point in this direction are neutral. Hence, as a matter of fact, there should seldom be the hesitation that interferes with the proper energy of treatment, and the statements often made in books are not true, —at any rate in the present day they should not be true. Stillness is the most important condition. The patient should be moved as little as possible, but placed in the recumbent posture with the head slightly raised. The neck should be freed from constriction. If the extremities are cold, warmth may be applied to them; and cold to the head if there is local heat or flushing. Sinapisms to the neck and extremities sometimes seem to hasten the return of consciousness. The administration of stimulants should be regulated by the state of the heart. In thrombosis or embolism the heart should be kept up to the normal by very careful administration of alcohol, ether, or ammonia. In hæmorrhage it may be allowed to fall a little below the normal, but indications of failing power should be watched for and counteracted. Where no causal indications exist, the latter is the wiser plan. Venesection and purgation are remedies of similar effect, but different in degree, and are indicated by high arterial tension and cephalic congestion, shown by incompressibility of the pulse and flushing of the face. Venesection is useful where the heart acts strongly, and the pulse is full as well as incompressible. Its effect is proportioned to the rapidity with which the blood is taken, rather than to the quantity removed. Purgatives remove serum from the blood, and lessen the amount of blood within the skull by causing an afflux to the capacious intestinal vessels. The best purgative is croton oil or calomel. With a failing heart and pale surface they should be avoided. When in doubt we should give a mild aperient that acts quickly, such as senna or a little solid extract of cascara rubbed up in water, and the action should be ensured by a glycerine enema. Diuretics may always be used to relieve the vascular tension. As the apoplexy clears, the nature of the case becomes evident, and the treatment of the several conditions is described elsewhere (*see* Brain, Hæmorrhage of, and Softening of). For treatment of the other causes of the apoplectic state, *see* Alcoholism, Poisons, and Uræmia.

W. R. Gowers.

APPENDIX VERMIFORMIS, Inflammation, Ulceration, and Perforation of.

Definition. — Inflammation of the appendix vermiformis from lodgment of hardened fæces or a foreign body; leading to ulceration, which frequently ends in perforation of its coats; and to inflammation (localised peritonitis) and suppuration (encysted suppurative peritonitis) of the adjacent tissues.

Ætiology.—The usual cause of this affection is a fæcal concretion, or a foreign body (*e.g.*, fruit-pips or -stones, a small bone, pins, shot, small gall-stones, &c.) imprisoned within the cavity of the vermiform appendix. Congenital deformities, and also twisting of the appendix on itself from contraction in its mesentery or from adhesions, are likewise important factors in inducing attacks. Perforation has been recorded in typhoid fever and tuberculous disease.

Anatomical Characters.—Before perforation takes place the appendix may be found distended with pus or mucus; a foreign body or concretion lodged within it; and the mucous membrane ulcerated. The concretion or concretions vary in size from a small pea to a bean; are usually brown and hard; and consist of layers of condensed fæces, secretions, and phosphates, deposited around a small nucleus, which may prove to be a seed or other foreign body, or a piece of unusually inspissated fæces. These concretions greatly resemble, and are often mistaken for, fruit-stones. The appendix may, however, be found perforated, and yet no foreign body can be discovered. Ulceration and perforation may occur at any part of the appendix, usually, however, at the extremity of the lower third. When twisted on itself, or when acutely bent by adhesions, the appendix may be found gangrenous, or may be so greatly distended by mucus (being large, round, and hard) as to seem as if it contained a concretion, with occlusion of its lumen. The appendix may be adherent to the cæcum, ileum, rectum, bladder, mesentery, or abdominal wall, with the signs of an ordinary local peritonitis; or there may be a circumscribed peritoneal abscess.

Symptoms.—Pain, generally ill-defined, in the right iliac region, may be the only symptom to attract attention, but, as a rule, it is not until local peritonitis or typhlitis is set up that we suspect the nature of the disorder (*see* Typhlitis). Now and then, however, the course from the first is latent, and the mischief is suddenly revealed by perforation into the peritoneum, followed by the symptoms of general and rapidly fatal peritonitis. Adhesions formed in front of the slowly advancing ulceration tend to localise the consecutive inflammation and abscess in other instances.

The substance imprisoned within the appendix may be dislodged (*a*) by an abscess opening externally (such as through the anterior abdominal wall, thigh, or scrotum), or into the abdominal cavity; or (*b*) by the perforated appendix establishing a communication with the cæcum, bladder, rectum, &c. The diseased and distended appendix—especially when its lumen is occluded, and there is little or no consecutive peritonitis—

may be not infrequently felt as a hard elongated body deep in the right iliac region, and can often be discovered by rectal examination, especially in young subjects.

Diagnosis.—Inflammatory affections of the appendix can rarely be clearly distinguished from those of the cæcum. Pains radiating to the testis or groin are more common in the form of 'typhlitis' than in the other varieties. The clinical and post-mortem observations of late years have clearly shown that peritonitis in the cæcal region—especially in its severe and relapsing forms—is more commonly the result of ulcerative inflammation of the appendix than of the cæcum. *See* Cæcum, Diseases of; and Typhlitis.

Prognosis.—General peritonitis from sudden perforation into the cavity of the peritoneum is the great danger, recovery from which is extremely rare. Inasmuch as this may occur at any time during the course of ulcerative inflammation of the appendix, a guarded opinion should always be given when there is suspicion of the existence of this affection. Continued uneasiness in the right iliac region without indications of fæcal accumulation, should not be regarded lightly. Though this serious accident is less apt to occur after the formation of adhesions around the advancing ulceration, we must not forget that well-marked local inflammation of the peritoneum does not always prevent it, inasmuch as the adhesions which are thus formed may not be sufficiently strong to withstand the pressure of pus in the appendix.

Treatment.—When there is suspicion of trouble in the appendix the patient must be kept at rest in bed, hot poultices applied, and an unirritating, very restricted fluid diet allowed. Opiates, for the purpose of controlling pain, should be continuously administered; and if irritability of the stomach exist, they should be introduced by enema or suppository, or by subcutaneous injection. Perforation and peritonitis, or other complications, must be treated as they arise. *See* Typhlitis.

Radical Surgical Treatment.—It has recently been shown[1] that an offending appendix may be removed, or a deformity of it corrected, with the happiest results in cases of relapsing typhlitis. The operation, performed in the quiescent period after subsidence of inflammatory and other symptoms, has prevented further relapses, and possibly averted a fatal perforative peritonitis. *See* Typhlitis.

George Oliver.

APPETITE, Disorders of.—In disease the desire for food may be either *lessened* or *increased*; or the appetite may be *perverted*, and a longing for various substances unfitted for or incapable of digestion may be displayed.

Loss of appetite—Anorexia accompanies fevers, almost all forms of congestion of the mucous membrane, and acute or chronic gastritis; and as these affections constantly coexist with other diseases, great variety as regards the desire for food is manifested in various complaints. In acute gastritis there is often not merely a loss of desire for, but a positive aversion to food, and the patient resolutely resists any attempt at obliging him to take either solid or liquid nourishment. In the more chronic forms of gastritis the distaste for food may be only slight; in some cases the appetite is increased, but is quickly satisfied as soon as a small quantity of food is taken. In chronic ulcer of the stomach the appetite, as a rule, remains good, and the patient is only prevented from indulging it by the fear of the pain that will result from so doing. Whenever the secreting structure of the organ is extensively diseased the appetite fails. Thus, in atrophy of the stomach the desire for food generally lessens along with the diminishing strength of the invalid. In cancer of the stomach there is always an extensive destruction of the glandular structure, and loss of appetite is a constant and prominent symptom. It must be remembered that a loss of appetite may be more apparent than real. The physician is constantly consulted on account of this symptom, when a little inquiry will show that the patient is really digesting as much as his system requires, but that by a habit of eating without allowing a proper interval between his meals, or by indulging in food of too nutritious a nature, or in an undue amount of alcoholic stimulants, hunger is prevented. For *Anorexia nervosa* see Neurasthenia.

Increase of appetite—Bulimia usually occurs where there is a necessity for an increased supply of food. Thus it is common after all febrile diseases, where the stomach has been long inactive. Again, in diabetes, where a large portion of the food is passed off in the form of sugar instead of being converted into the material required to keep up the nutrition of the body, there is an unusually large appetite. A craving sensation is a common symptom in chronic catarrhal gastritis. It probably arises from the irritation set up by the mucus and fermenting substances long retained in the stomach, and is temporarily relieved by eating. The best treatment for such cases is to give alkalis about half an hour before the craving usually occurs, at the same time that the affection of the mucous membrane is combated by appropriate diet and remedies. In some persons the sensation of extreme hunger appears to arise from an irritable condition of the stomach, by which the food is passed into the duodenum before digestion is completed. The sensation is mostly complained of at night, and the writer has found it a good plan to let the patient have some beef-tea or meat lozenges, for example, either just before retiring to rest or during the night. In children a craving for food is a frequent symptom, and arises either from the irritation of worms, or from chronic catarrh of the mucous membrane of the small intestines.

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[1] See Treves, *Med.-Chir. Trans.*, vol. lxxi. p. 165, and *The Lancet*, Feb. 9, 1889.

Perversion of appetite—*Pica* is most common in pregnant or hysterical females. Articles, such as chalk, cinders, and slate-pencil, are sometimes swallowed. In the insane and in idiots articles of an indigestible nature are not infrequently introduced into the stomach, such as string, paper, cocoa-nut fibre, &c.

It is a matter of great importance that all persons, but especially dyspeptics, should accustom themselves to control their appetites. Whenever a larger amount of food is taken than the stomach is capable of digesting, the residue is apt to ferment and thereby to produce gastric catarrh. This is more especially the case where the digestive powers have been enfeebled by previous attacks of gastric inflammation.

S. Fenwick.

APYRETICS.—*See* Antipyretics.

APYREXIA (ἀ, priv.; and πυρέσσω, I am feverish.)—This word literally means absence of fever. It is also used to denote the interval between paroxysms of intermittent fever. *See* Fever.

ARACHNITIS.—Inflammation of the arachnoid membrane. *See* Meningitis.

ARCACHON, West Coast of France. Summer and autumn resort. Sheltered by pine-woods. Calm in winter. *See* Climate, Treatment of Disease by.

ARCUS SENILIS.—Synon.: Gerontoxon.

Description.—Arcus senilis is a crescentic or annular opacity just within the margin of the cornea, often seen in old persons. It usually begins as a greyish or whitish crescent at the upper part of the cornea, and subsequently a similar crescent makes its appearance in the lower part. These crescents gradually increase in opacity, in width, and in length, until their horns coalesce and form an *annulus* or ring. A true arcus is not quite continuous with the sclerotic, but is separated from it by a narrow rim of transparent cornea. The breadth of the crescent or ring generally ranges from one-twentieth to one-tenth of an inch. The opacity is more pronounced at its outer border, but fades insensibly towards the central portion of the cornea, which is of normal transparency.

Ætiology and Pathology.—The proximate causes of arcus are not known. Some families are especially prone to it, and it most frequently occurs in persons of fifty years of age and upwards. The opacity is commonly believed to be due to fatty degeneration of the corpuscles and fibrillæ of the cornea, and to be indicative of degenerative changes within the heart and blood-vessels and other textures. There is, however, a growing consensus of opinion that both its pathological and clinical significance have been overrated. Certainly it is, in itself, no criterion of age, either as regards years or constitution. On the one hand it may occur in young persons, and on the other hand it may be absent in extreme old age. Again, it may exist in persons free from any appreciable signs of arterial or cardiac disease, and it may be absent from those who have pronounced degeneration of the heart and blood-vessels. It is, nevertheless, true that arcus senilis is due to degenerative changes within the cornea, and that it does sometimes co-exist with atheroma or with fatty heart. According to some investigations made by the writer, in conjunction with Mr. E. T. Collins, in the laboratory of Moorfields Eye Hospital, the change in the cornea consists of the presence of fine, highly refractive molecules, distributed along the course of the lymphatic spaces and channels of the superficial layers of the periphery of the cornea near the loop-endings of the capillaries of the conjunctival and episcleral blood-vessels. The greater portion of these molecules are not fatty, as is generally supposed; for, unlike fat, they are neither blackened by osmic acid nor dissolved by ether. They probably arise from mucoid degeneration of the protoplasm within the lymphatic channels and spaces of the cornea, and to some extent of the fibrillæ themselves. A few doubtful, blackened, fatty molecules may be seen here and there in sections stained by osmic acid. The fibrillæ are slightly wrinkled, and are more loosely held together than natural, and the spaces between the laminæ are wider. In support of the non-fatty nature of arcus senilis it may be stated that wounds of the cornea, whether through the opacity, or to its inner side, or to its outer, and whether surgical or traumatic, heal in a natural way.

Treatment.—The condition is incurable, and is unaffected by any kind of treatment.

John Tweedy.

ARDOR (*ardor*, heat).—A sensation of heat, burning, or scalding. It may be felt either along the urethra during the passage of urine (*ardor urinæ*); or in connexion with the stomach (*ardor ventriculi*).

ARGYRIA (ἄργυρος, silver).—The slate-coloured stain of the skin produced by the internal use of the salts of silver. *See* Pigmentary Affections.

ARKANSAS SPRINGS, in Arkansas, United States.—Thermal waters. *See* Mineral Waters.

ARSENIC, Poisoning by.—Arsenic is classed as a metallic irritant poison, though its action is by no means limited to that of an irritant. It acts specifically on the gastro-intestinal mucous membrane, whatever be the channel by which the poison gains access to the system. The most usual source of acute arsenical poisoning is the administration of white arsenic or arsenious acid; but the sulphides, various arsenites, and impure commercial articles, such as dyes, wall-papers, and pigments, may be fertile sources of arsenical poisoning. Poisoning by arsenic may be either *acute* or *chronic*.

Anatomical Characters.—These are the same by whatever channel the poison has gained access to the system. There is marked petechial inflammation of the stomach and duodenum, usually of the small and large intestines also; but not uncommonly the inflammation is limited to the stomach, duodenum, and rectum, the intervening alimentary tract having escaped. If the poison has been administered in a solid form, white patches of the arsenical compound may be found embedded in yellow or bloody mucus and inflammatory exudation. Portions of the white arsenic are also sometimes converted by the sulphuretted hydrogen evolved during decomposition into the yellow sulphide. Ulceration of the stomach is rare. Neuritis may be observed. An ecchymosed condition of the heart is often observed; and fatty degeneration of the liver, as in poisoning by phosphorus, has been described.

A. **Acute Arsenical Poisoning.**—This is the usual form of poisoning ensuing on the nefarious administration of any preparation of arsenic, but usually the oxide (*arsenious acid*) is employed.

Symptoms.—The symptoms do not, as in the case of corrosive poisoning, come on immediately after the administration of the poison. There is most commonly an interval of half an hour or an hour between the swallowing of the agent and the onset of prominent symptoms. The quantity of the noxious agent, and its state as regards solubility, have also an obvious relation to the commencement of symptoms. Most commonly, after a sense of faintness and depression, intense burning pain is felt in the epigastric region, accompanied by tenderness on pressure. Nausea and vomiting quickly supervene, increased by every act of swallowing. Unlike what occurs in an ordinary bilious attack, with which arsenical poisoning may be at first confounded, the pain and sickness are not relieved by the act of vomiting. The vomited matters are extremely varied, and present no characteristic appearances. At first they usually consist of the ordinary contents of the stomach, but at a later stage are largely charged with bile which has regurgitated into the stomach in consequence of the violence of prolonged emesis; and they may be tinged with blood. Ordinarily vomiting is speedily followed by violent purging, and great straining at stool, the motions being often streaked with blood. Purging may, however, be entirely absent. Other prominent symptoms are great thirst, a feeble irregular pulse, and cold clammy skin. The patient, as a rule, dies within eighteen to seventy-two hours, in a state of collapse; but tetanic convulsions are not uncommon, and even coma and paralysis may close the scene.

Diagnosis.—From an ordinary bilious attack, induced by improper diet or by decomposing food, arsenical poisoning is diagnosed by the persistence of the symptoms after the removal of the apparent cause; and not infrequently by the symptoms remitting and again supervening on the administration of food or drink of a particular kind, or given by a particular hand. From choleraic diarrhœa it is distinguished by the *sudden* onset of symptoms, thirty to sixty minutes after food or drink has been taken; by the absence of rice-water stools, or of lividity of the skin; and by the symptoms not yielding to treatment. Moreover, in poisoning by arsenic there is usually greater tenderness over the epigastrium; the diarrhœa is less passive, and accompanied with more tenesmus than in choleraic diarrhœa; the stools are more often bloody; and nervous symptoms may be more pronounced. The diagnosis is, however, often very difficult, except when aided by a chemical analysis of the matters ejected from the stomach or of the excreta, which should always be made in doubtful cases.

Prognosis.—This must always be uncertain, since it is rarely possible to ascertain the quantity taken, or to ensure its entire evacuation from the stomach.

Treatment.—Emetics, diluents, and demulcents are the appropriate remedies. The stomach-pump may also be usefully employed. In administering emetics, tartar emetic should be avoided, as it increases the depression, and its presence complicates a chemical analysis. Moreover, tartar emetic sometimes contains traces of arsenic, and, in the event of an analysis being made, an unfounded suspicion may be raised. No confidence can be placed in the so-called antidote, *ferric hydrate*, but dialysed iron may be freely given.

B. **Chronic Arsenical Poisoning.**—This form of poisoning is not uncommon, and is, unlike the acute form, generally accidental. The inhalation of arsenical vapours in factories, or of arsenical dust, as from green and other wall-papers, and in the process of manufacturing artificial flowers, is a common source of chronic arsenical poisoning.

Those who are chiefly exposed to this form of poisoning are persons employed in the manufacture of pigments, especially green pigments; paperhangers and decorators; artificial-flower manufacturers; milliners; persons exposed to the fumes of heated metals, particularly zinc and brass; manufacturers of dyes; and leather-dressers. In the process of depilating sheep-skins, previous to the tanning or the tawing process, a mixture of lime and orpiment (*sulphide of arsenic*) is used; and serious ulceration of the hands, scrotum, nose, and cheeks not infrequently results. Persons living in rooms the walls of which are covered with arsenical paper, especially bright-green papers containing arsenite of copper, are liable to suffer from chronic arsenical poisoning. It is uncertain whether this is entirely caused by the mechanical transfer of pigmentary dust to the air-passages, or is partly due to volatilisation of the arsenic, probably in the form of arseniuretted hydrogen. Many brown wall-papers also contain arsenic, and arsenious acid is sometimes added to the size; such papers have been known to produce the specific symptoms of arsenical poisoning.

That some persons can take arsenious acid internally with impunity in relatively large doses (arsenic-eating) is now a well-established fact.

Symptoms.—The first symptoms of chronic arsenical poisoning are usually loss of appetite, præcordial pains, irritability of the bowels, and occasionally headache. Suffusion of the eyes, a peculiar and characteristic appearance of the conjunctiva, often amounting to actual conjunctivitis, and intolerance of light are early manifested. The muscular power of the limbs is impaired pretty constantly, and actual paralysis, extending upwards from the lower extremities, is occasionally observed (*see* Paralysis, Toxic). A characteristic vesicular eruption on the skin (*eczema arsenicale*) is frequent, as well as irritation of the skin, especially over the neck, scalp, hands, and armpits. Males who handle arsenical preparations are liable to ulcerations of the scrotum and penis, obviously due to a mechanical transference of the poison to the genitals when these are touched. If the source of the disease be not removed, progressive emaciation, exfoliation of the cuticle, and nervous prostration supervene; and convulsions may precede the fatal termination. The effects of green arsenical pigments are sometimes manifested by bleeding from the nose.

Diagnosis.—When a patient suffers more or less from the symptoms above described, and is also known to be exposed to any of the sources of danger from arsenical poisoning enumerated above, the diagnosis is not difficult.

Treatment.—The source of poisoning should invariably be removed. It is found that those who suffer from working in arsenic make no progress towards recovery until they are removed from contact with the poison. Wall-papers which contain arsenic, and are suspected to be the cause of symptoms, should be taken away. Quinine, or other tonics, iron, and attention to the digestive organs will be needed. Removal to fresh country air is often productive of marked benefit. Soothing lotions to the skin, and careful attention to eroding ulcers, especially of the cheek, may be necessary. Shampooing and warm baths form the best treatment for paralytic lesions.

T. Stevenson.

ARTERIES, Diseases of.—It is important to keep in mind the following anatomical facts in studying the morbid processes to which arteries are subject:—In immediate contact with the blood-stream in arteries lies the *endothelium*—a layer of flattened cells; outside this is the *tunica intima*, composed of elastic tissue, in longitudinal arrangement: together the endothelium and tunica intima constitute the *internal coat* of the older writers. Still more external we find the *middle coat*, made up of muscular fibre arranged transversely, in the larger arteries mixed with elastic tissue. And, most external of all, there is the *external coat*, consisting of longitudinally fibrillated connective tissue.

1. Acute Arteritis.—Acute arteritis, affecting a very limited portion of a vessel, and leading to ulceration, occasionally occurs. It is generally due to the propagation of an inflammation from the tissues of the vicinity to the external coat of the vessel, but in some cases it arises from the irritation caused by an embolus, which, becoming detached from a cardiac valve, blocks a distant artery. The late Dr. Moxon has specially drawn attention to its occurrence in the aorta, when the ascending portion of the vessel has been exposed to the impact of a hard, freely moving vegetation on one of the segments of the aortic valve. Dr. Moxon has also described, under the designation *inflammatory mollities*, the occurrence of softening and swelling of the arterial tunics in circumscribed spots, which become flabby and inelastic, and ultimately bulge outwards and form aneurysms. He believed that this condition depends on a peculiar general state, and is the great cause of aneurysm in young, hard-working men. Except such circumscribed inflammatory lesions, we do not meet with any condition of the arterial tunics to which the designation acute arteritis can be applied. A general inflammatory change has, indeed, been described, and the writers have seen the lining membrane of the ascending and transverse portions of the aorta of a bright vermilion hue, strongly suggestive of acute inflammation; but the best observers are agreed in believing that this appearance arises from staining by hæmatin.

2. **Endarteritis obliterans.**—This is an affection of the small arteries which causes narrowing of their calibre by thickening of the internal coat. It is not an independent disease, and is most commonly found in the cirrhotic kidney, where it is usually accompanied by periarteritis. *See* Gummatous Disease, page 115.

3. **Periarteritis.**—Periarteritis is mostly a chronic change, and consists in the production of diffuse or circumscribed thickenings of the arterial walls by a new formation of connective tissue in the external coat. It is to a periarteritis that Charcot and Bouchard ascribe the lesions which, in their opinion, eventuate in cerebral hæmorrhage. According to these physicians, cerebral hæmorrhage is not usually due to atheromatous decay of the vessels of the brain; but, in the vast majority of cases, to the rupture of miliary aneurysms, which in their turn have been produced by a morbid process beginning in the perivascular sheath surrounding the cerebral vessels, and which, proceeding from without inwards, ultimately involves all the coats of the vessels. *See* Brain, Hæmorrhage into.

4. **Atheromatous Disease.**—This disease, the *endarteritis deformans* of Virchow, is the arterial disease which is most frequently met with, and the one whose consequences are most serious. It may be divided, for purposes of description, into three tolerably well-defined stages:—(*a*) In the *first* stage we notice, when the vessel is slit open, greyish patches, by which the lining membrane is irregularly thickened; these patches seem to lie on the surface of the membrane, but this appearance is deceptive; the endothelium lies between them and the blood-stream, and is, at least at the beginning of the morbid process, unaffected. The material of which the patches consist is situated in the tunica intima; it is gelatinous, or semi-cartilaginous, in consistence; and is formed, according to Virchow, by an abnormally rapid multiplication of the deeper cells of the tunica intima,—the new growth pushing up this tunic with its superimposed endothelium, and so causing a bulging into the interior of the vessel. But, in addition to these proliferated elements, round cells, derived from the vasa vasorum, are often present in all three coats; and it would appear that the process often begins as an inflammation, and perhaps less commonly as a hyperplasia, of the tunica intima. (*b*) In the *second* stage the cellular elements of which the new growth is composed undergo a process of fatty degeneration; and in consequence it becomes yellowish in colour and pasty in consistence: it was the paste-like appearance of the mass in this stage which originally gained for the process the designation *atheroma* (ἀθήρη = meal). It not infrequently happens that the whole of the internal coat with its endothelium is involved in the softening, and gives way under the pressure of the blood, leaving an excavation, the floor of which is formed by the middle and external coats of the artery. (*c*) In other instances, however, the pasty mass, instead of being washed away, becomes the seat of calcific deposit. This is the *third* stage in the process. The appearance of a vessel in which atheromatous disease has reached this stage is very striking: plates, which present to the naked eye the appearance but do not show the minute structure of bone, are observed at intervals in the walls of the vessel, and their sharp spicula project into its interior; in the aorta it is not uncommon to find such plates an inch long and half an inch broad, and in the smaller arteries the calcareous matter sometimes forms a ring round the vessel. In the latter the calcareous particles appear to be deposited in the patch while it is still firm, so that the second stage of the process is wanting.

The changes above described may be confined to the internal tunic, but the two outer coats are often implicated as well. In the media we may have round-celled infiltration, induration, fatty degeneration, and calcification, while the external coat may be thickened by newly formed connective tissue. Indeed according to Thoma, the primary change is a lesion (weakening or atrophy) of the middle coat. *See* Aorta, Diseases of, page 90.

Atheromatous disease sometimes invades both the aorta and the small vessels, but the aorta may be extensively diseased and the small arteries unaffected; or, on the other hand, the cerebral, temporal, and coronary arteries may be the seat of calcareous change while the great vessels are healthy; occasionally the disease is limited to a few vessels. Next to the aorta, the cerebral, coronary, and splenic vessels, and the arteries of the lower extremities, are prone to this form of arteritis.

Effects.—The dangers to which an atheromatous state of vessels exposes the person in whom it exists are varied. The stream of blood is retarded by the projection of the new growth into the vessel, and still more by the destruction of the elasticity of its coats; and hence ensues a failure in the nutrition of the organ, which depends for its supply of blood on the diseased vessel—this is one cause of cerebral softening. When the paste-like mass is washed away it sometimes happens that the blood insinuates itself between the coats of the vessel, producing a dissecting aneurysm; or the portion of the vessel which has been weakened by the removal of the internal coat yields to the pressure of the current, and a sacculated aneurysm is originated; sometimes the diseased vessel bursts. Cerebral vessels, probably on account of the thinness of their walls, are specially liable to rupture when they are the seat of atheromatous change; and occasionally a diseased coronary artery has given way, filling the pericardium with blood. Arteries have been completely occluded by the deposition of fibrin on the spiculated edges of calcareous plates: this is one of the causes of senile gangrene; and embolic plugging of distant vessels at times results from the detachment of such fibrinous clots, and the washing away of atheromatous débris. Rigidity of the larger arteries from atheromatous change is likewise one of the most frequent causes of hypertrophy of the left ventricle of the heart, on which increased work is imposed in consequence of the destruction of the elasticity of the vessels. Anasarca has not, so far as the writers are aware, been mentioned by any author among the consequences of diseased arteries; but some cases which have come under their observation have led to the conclusion that persistent anasarca, especially of the lower extremities in elderly men, is sometimes mainly due to a diseased condition of the arterial tunics. In the cases observed there was likewise present dilatation with hypertrophy and commencing fatty change of the left ventricle, itself a consequence of the arterial disease; but this seemed insufficient to account for the persistent œdema of the lower extremities.

Ætiology.—The principal cause of endarteritis deformans is now generally admitted to be overstrain of the vessel. It was formerly thought, and is still held by many, that syphilitic impregnation of the system is a powerful favouring condition; but this opinion rests chiefly on observations made among soldiers, who, in addition to the syphilitic taint, were subject to other influences now known to be adequate in themselves to develop the disease. Intemperate habits and gout appear to be powerfully predisposing causes. They probably render the blood impure; and its passage through the capillary vessels being thereby retarded, the tension of the arterial system is increased. Besides violent exertion, which imposes a strain on the entire arterial tree, there are other influences which act upon certain vessels. Thus the renal arteries are kept overfull in the cirrhotic form of Bright's disease, owing to the destruction of the capillary tufts, and hence atheroma of these vessels is frequently present in that form of renal mischief. One of the writers has on two occasions found extensive calcareous formations in the cerebral vessels of persons in whom cerebral degeneration had followed excessive anxiety and mental effort. The pulmonary artery is very rarely invaded by atheroma; and only in cases in which it has been kept in a state of tension by hypertrophy of the right ventricle or disease of the mitral orifice.

Diagnosis.—The diagnosis of atheromatous inflammation of the aorta is discussed in a separate article. The existence of the disease in the arteries of particular organs can only be a matter of reasonable presumption when the patient is past middle life; when the ascertained causes of atheroma have been in operation; when symptoms of impaired nutrition of the organ are present; and when the organ (the brain or heart) is one the arteries of which are known to be prone to the disease. Calcification of the superficial arteries renders these vessels rigid and tortuous. The temporals when so affected attract the eye by their prominence, and may be felt hard and rigid beneath the finger; the brachial may equally be made the subject of examination; and, although the presence or absence of atheromatous change in such superficial vessels does not necessarily prove that the other arteries of the body are in a similar condition, it renders it more than probable that they are. Those who are not familiar with the resisting feel of the radial artery, when it is the seat of the change now under consideration, are liable to form a very erroneous estimate of the strength of the pulse: this may convey to the inexperienced finger an impression of a force which it does not possess. The error also is sometimes committed of inferring the existence of aortic regurgitation in these cases in consequence of the tortuous course and visible pulsation of the superficial vessels; but they do not collapse suddenly under the finger, as do the vessels during the receding wave in aortic patency. The sphygmographic tracing, moreover, is essentially different; in atheromatous disease of the artery the upstroke is vertical, and the summit of the tracing extended. The existence of such evidences of vascular mischief affords a fair subject for consideration to those who are called upon to form an opinion as to the eligibility of a life for assurance.

Treatment.—The treatment of endarteritis deformans is mainly preventive. It consists in the avoidance of all those influences to which we have adverted as causes of the disease, namely: indulgence in alcohol; causes originating a gouty state of the blood; excessive muscular efforts, especially in constrained positions; and postures which involve the long-continued contraction of muscles which surround arteries. As far as the brain and heart are concerned, all those states must be forbidden which favour overfulness of their respective arteries: in the case of the brain, excessive mental application, deficient sleep, and, the writers believe, prolonged periods of sexual excitement; in the case of the heart, *inter alia*, efforts which involve holding the breath, thus leading to distension of its right cavities, and imposing an obstacle to the return of blood from its walls.

5. **Fatty Degeneration.**—Fatty degeneration, unconnected with the atheromatous process, is sometimes found to affect arteries. Circumscribed opaque and velvety spots appear on the surface of the intima, and erosion ultimately occurs. Once this has taken place, the muscular coat, which

may itself be fattily degenerated, unable to bear the pressure of the blood-stream, fissures transversely; and the blood may rupture the external coat, or, insinuating itself between the middle and external coat, produce a dissecting aneurysm. The fatty change is met with in extreme anæmia and in senile marasmus, but has also been found in the arteries of persons who seemed otherwise quite healthy; it is 'a morbid change which is simply degenerative from the first, and of whose immediate cause we know nothing' (Rindfleisch). Fatty degeneration of the external coat of the smallest arteries has also been noticed; it appears to be a senile affection.

6. **Calcification.** — This disease of the arterial tunics also occurs unconnected with endarteritis, but more rarely than fatty degeneration. When this is the case, it is most frequently the middle coat of the medium-sized vessels that is the seat of the deposit, but all three tunics may be involved. The process is usually limited to the vessels in which muscular fibre is abundant; but these it may affect extensively, the superficial vessels and the arteries of the brain and of the extremities being the favourite seat. It is eminently a senile change.

7. **Gummatous Disease.**—In this condition the vessels present nodose swellings, and are thickened sometimes to three times their normal size by gummatous material infiltrating the outer coat. According to Heubner, the disease begins in the intima by a proliferation of the cells of the endothelium, which may be so excessive as to cause complete obliteration of the lumen of the vessel. The middle and external coats only subsequently become infiltrated with round cells. The lesion described by him, however, is common to all forms of endarteritis obliterans, and is not distinctively syphilitic. 'A random succession of nervous symptoms,' to use the words of Dr. Hughlings Jackson, affords strong grounds for suspecting syphilitic disease within the cranium; and one of the writers has himself seen three cases in which such symptoms disappeared under the use of perchloride of mercury and iodide of potassium, and in which it seemed to him that the supposition of arterial disease was much more probable than that of any other form of intracranial syphilis.

8. **Albuminoid Disease.**—This, when it attacks an organ, very commonly appears first in the walls of the small arteries, the muscular coat being the part affected.

9. **Hyaline Degeneration.**—This degeneration may attack the smallest arteries, and give rise to a continuous thickening of their coats, with ultimate occlusion of the vessel; or it may result in the production of isolated masses of hyaline material, which lie principally between the tunica intima and tunica media.

10. **Contraction.**—Contraction and final impermeability of an artery from atheromatous calcification, from the accumulation of fibrin on its rough inner surface, from pressure, or from other causes, occasionally occurs, leading to gangrene of the extremity which it supplied.

11. **Dilatation.**—Dilatation of arteries is in the majority of cases due to previous disease of their coats; but sometimes in the aged the arteries are found dilated without any degeneration of their tunics being present,—a state of affairs which Rindfleisch suggests may depend on atony of the muscular coat, and in some cases may possibly be connected with deficient innervation.

12. **Aneurysm.**—Aneurysm receives full consideration in a separate article. Here it is merely necessary to point out the ways in which atheromatous inflammation and the other morbid processes which have been described contribute to the production of dilatation and aneurysm. In some cases the course of events consists in the washing away of the diseased patch of the intima; when the middle coat either dilates, or, by separation of its muscular bundles, undergoes rupture, and the external coat yields before the pressure of the blood-stream. In other cases the dilatation occurs, not at the point where the endarteritis has invaded the vessel, but nearer to the heart. At the affected point there is narrowing of the canal of the vessel, and loss of elasticity in its coats; and, as a consequence, we have slowing of the circulation and deficiency in the supply of blood beyond, and increased arterial tension on the proximal side of the affected spot. The effect of this tension is more serious than would at first sight appear. In health the blood, propelled by each ventricular systole, enters contracted vessels, which, yielding before it, are uninjured by its sudden impact; but a vessel in a state of tension is exposed to the full violence of the column of blood discharged by the heart, and must gradually dilate before it.

13. **Arterial Disease in Insanity.**—According to Dr. J. Batty Tuke, and other physicians who have specially investigated the morbid changes in the brains of the insane, arterial disease is almost invariably present. It consists in such alterations as would result from obstruction in the ultimate ramifications of the vessels : thickening of the proper coats of the arteries, and of the sheath of connective tissue which surrounds the cerebral vessels; the deposition of fine molecular matter and crystals of hæmatoidin between the adventitia and the sheath; and extreme tortuosity of the vessels.

14. **Arterio-Capillary Fibrosis.**—This term was applied by the late Sir William Gull and Dr. Sutton to the hypertrophy of the walls of the small arteries found in the subjects of the cirrhotic form of Bright's disease.

It is admitted by all observers of repute that the walls of the blood-vessels of the kidney are greatly thickened in this malady; but it is by no means so universally admitted that the small arteries throughout the whole body are in all such cases hypertrophied. That they are hypertrophied in a certain proportion of the cases admits of no doubt; but there is a difference of opinion as to the nature of the thickening. Dr. George Johnson, who early called attention to this condition, considers that there is present a hypertrophy of all the tunics of the small arteries, especially of the muscular coat—a consequence of the obstruction which impure blood invariably meets with in the capillaries. Sir William Gull and Dr. Sutton, on the other hand, asserted that the thickening is due to a fibroid growth, especially seated in the external coat of the vessel; and they believed that the coexisting disease of the kidney is not the cause of the arterial change, but that both are parts of a general diseased process.

James Little. A. B. McKee.

ARTERIES, Examination of.—*See* Physical Examination; and Pulse.

ARTHRALGIA (ἄρθρον, a joint; and ἄλγος, pain).—Pain in a joint. The term is more particularly applied to articular pain in the absence of objective disease. *See* Joints, Diseases of.

ARTHRITIS (ἄρθρον, a joint).—A term generically used to signify any disease whatever involving a joint, but more correctly confined to articular inflammation. It is also employed to designate inflammation of *all* the structures forming a joint, as distinguished from mere synovitis. *See* Joints, Diseases of.

ARTHRODYNIA (ἄρθρον, a joint; and ὀδύνη, pain).—Pain in a joint. *See* Arthralgia.

ARTICULAR RHEUMATISM.—Rheumatism affecting joints. *See* Rheumatism, Acute.

ARTIFICIAL RESPIRATION.—The method of exciting and keeping up the movements of the chest, so as to supply air to the lungs, is a subject of the highest importance, since the hopes of recovery depend on its due performance in many cases of narcotic poisoning, in the apparently drowned or asphyxiated, and in the collapse of the advanced stage of the condition induced by anæsthetics.

Precautions.—For its effective employment it is essential to see that no foreign body obstructs the air-passages. Children and old people are liable to swallow large pieces of meat or crust, which become impacted in the pharynx or œsophagus. A clot of blood may threaten life in operations about the mouth. These should, if possible, be dragged away with the finger or a spoon-handle, but they may require the use of a probang. Tracheotomy is rarely necessary. A knife-handle held between the molar teeth is a ready and useful gag to keep the mouth open. A button-hook, in the absence of pharyngeal forceps, is sometimes very serviceable. Vomited matter should be quickly removed with a sponge or cloth twisted round a piece of wood. In treating the half-drowned the body should be inverted for a few minutes to favour the escape of water from the air-passages, but artificial breathing should be commenced even whilst the body is in this position.

Methods.—In most cases the best method of commencing artificial respiration is to compress the chest and abdomen simultaneously, then remove pressure so as to allow air to enter the chest, and again repeat the pressure every two or three seconds. If the sound indicates that air is passing into and out of the lungs, this method may be continued for half a minute; but if we are not sure that the air is exchanged, and in all cases if the patient's condition is not decidedly improved in half a minute, we should resort to one or other of the following methods:—

1. *Howard's method.*—This method is so important that it is considered separately under Resuscitation.

2. *Sylvester's method.*—Place the patient on his back on the floor, with a block or pillow under his shoulders, and raise the arms upwards above his head, by grasping them above the elbow, and pulling firmly and steadily as long as there is any sound of air entering the chest. Some arrangement is needed to prevent the body from being dragged towards the operator. For this purpose the plan of raising the chest on a high cushion or box has been adopted, but as a condition of cardiac anæmia is often present, this is objectionable. It is better to effect the object by placing a book in front of the thighs while kneeling at the head of the patient. It may be needful to draw forward the tongue; but generally if the head falls back over a cushion placed behind the neck, this is not required. An artery-forceps, or a noose of string, or a handkerchief will enable an assistant to keep the tongue well forward.

As soon as the sound produced by the entrance of air into the chest ceases, the arms should be brought down a little towards the front of the chest, and pressed firmly and steadily against it for about one second after air is heard escaping. In cases of drowning it is enough to repeat this operation every four seconds, but in the collapse resulting from chloroform or other anæsthetics, the necessity for getting the vapour quickly out of the chest justifies a more rapid performance of the movements during the first five minutes. After this time the movements should be carried on more slowly, but they should be continued for half an hour at least, and even longer if the warmth of the surface and diminution of lividity gives any reason to hope that the heart has not entirely ceased to act.

3. *Marshall Hall's ready method.*—This is performed by placing the body on one side, and alternately rolling it on its face to compress the chest, and on its back to allow the elasticity of the ribs free movement to draw air into the lungs. The plan is not nearly so effective as Sylvester's, but if no assistant is at hand it is the best mode of artificial breathing that can be adopted.

4. *Mouth-to-mouth insufflation.*—This method is not to be depended upon, because of the difficulty both of keeping the larynx open, and also of preventing the air going down the gullet.

Of the *instruments* introduced for the purpose of carrying on artificial respiration, mention should be made of those invented by Dr. Marcet, Dr. Richardson, and Dr. Vanderburg; but, except in the hands of the inventors or of those who had gained much experience in their use by practising upon animals, they would probably do as much harm as good. The objection to them all is that they interfere with the prompt imitation of the movements of respiration just described.

The administration of *oxygen* is indicated in most cases of artificial respiration, but the results of its use have not been satisfactory hitherto. Now that the gas can be had in a compressed state, and can be given by means of the laughing-gas inhaler, it is worthy of a further trial; but it is certain that in all cases of impending asphyxia time is of so much importance that anything which would delay the supply of oxygen would not be compensated for by giving it pure, instead of in the form of common air. Tracheotomy is not to be thought of in the first instance in any case in which air can be made to pass, even in very small quantity, through the trachea.

For supplemental and after treatment, *see* RESUSCITATION.

J. T. CLOVER. G. H. BAILEY.

ASCARIDES.—*See* ENTOZOA.

ASCITES (ἀσκὸς, a leathern sac: a large belly).—SYNON.: Dropsy of the peritoneum; *Hydrops peritonei vel abdominis; Hydroperitoneum.* Fr. *Ascite*; Ger. *Die Bauchwassersucht.*

DEFINITION.—An accumulation of fluid within the cavity of the peritoneum, more or less serous in character; the accumulation being of the nature of a local dropsy, and not originating in inflammation. The amount of fluid varies much in different cases.

ÆTIOLOGY AND PATHOLOGY.—The chief matter relating to the causation of ascites is to point out the morbid conditions by which it may be produced, as it almost always follows, and is a consequence of certain pre-existing organic diseases, of which it becomes a most important symptom and pathological phenomenon. The causes to which it has been attributed may be discussed according to the following arrangement:—

I. Direct mechanical obstruction affecting the portal circulation.
 1. Obstruction of the trunk of the portal vein before it enters the liver, either from external pressure or an internal block.
 2. Pressure upon or obliteration of the branches of the vein within the liver.
 3. Pressure upon the hepatic veins, or upon the inferior vena cava after it receives these veins.
II. Cardiac or pulmonary diseases obstructing the general venous circulation.
III. Disease of the kidneys.
IV. Morbid conditions of the peritoneum.
V. Miscellaneous.

I. Any direct obstruction interfering with the portal circulation must necessarily lead to congestion and over-distension of its tributaries, one of the consequences of which is excessive transudation of the fluid portion of the blood into the peritoneal cavity, while absorption is checked. The ascites is, under such circumstances, in short, merely a localised dropsy, resulting from mechanical congestion. The impediment may affect either the portal trunk before it enters the liver; its branches in the substance of this organ; or the hepatic veins or the inferior vena cava near its termination.

1. The portal trunk may be pressed upon, as it lies in the fissure, by prominences from the liver itself, enlarged absorbent glands in its vicinity, a neighbouring tumour (as cancer of the pancreas, or a growth in the small omentum), a hepatic aneurysm, or inflammatory thickening resulting from peri-hepatitis. The pressure may absolutely close up the vessel, but it more commonly causes a local clot to form, and thus its channel is blocked up. A thrombus is also in exceptional instances produced in connexion with a diseased condition of the portal vein, such as inflammation or calcification; obstruction to the circulation within the liver; or feebleness of the circulation, with an abnormal tendency to coagulation of the blood.

2. Pressure upon, or obliteration of the branches of the portal vein within the liver, can only arise as a consequence of some morbid condition involving the actual substance of this organ. The hepatic disease which by far most commonly leads to this result, and which is one of the most frequent causes of ascites, is cirrhosis. Occasionally it accompanies syphilitic and other forms of contracted and indurated liver, or it may be associated with infiltrated cancer. The extent of the obstruction thus set up will necessarily vary with that of the morbid changes in the organ. Occasionally a mass within the liver obstructs a considerable branch of the portal vein.

3. Obstruction of the hepatic veins, or the upper end of the inferior vena cava, is a rare event, but may arise from the pressure of a growth connected with the liver itself, or of some neighbouring tumour.

II. Diseases of the lungs or heart which impede the general venous circulation must necessarily exercise a speedy and direct influence upon the hepatic circulation, and may thus lead to ascites. Usually, however, in cases of this kind the legs are the seat of considerable anasarca before peritoneal dropsy is observed. In course of time the continued venous congestion originates serious organic changes in the liver, its vessels being more or less obliterated, and consequently it is at this period that ascites is particularly liable to set in, and it may even become the most prominent form of dropsy.

III. Ascites may constitute a part of the dropsy which so often accompanies renal disease. It is, however, of comparatively infrequent occurrence to any great extent under these circumstances, the amount of fluid being not considerable as a rule, and the ascites being but a subsidiary part of a general dropsy.

IV. More or less serous effusion into the peritoneal cavity is a pathological result of peritonitis; but, in accordance with the definition of ascites given above, this does not come strictly within the present article. Exceptional cases do occur, however, in which a large effusion rapidly collects in the peritoneum, and it is difficult to say whether it is a mere dropsy or the product of an acute inflammation. Moreover, true ascites is observed occasionally as a sequel of peritonitis, in consequence of the morbid conditions which it leaves behind. Chronic peritonitis may also occasion a simple local dropsy; but this is particularly liable to be set up in connexion with morbid formations in the peritoneum, such as cancer or tubercle. The immediate causes of ascites associated with diseases of the peritoneum may be active congestion; implication of the capillaries or minute veins, or even of the larger veins, leading to mechanical congestion; obstruction of the lymphatic orifices, and consequent impairment of absorption; or undue activity of the secreting structures.

It may be mentioned in this connexion that ascites is sometimes associated with a tumour which does not directly interfere with the portal circulation; probably it is then due to irritation of the peritoneum.

V. Among the chief *miscellaneous* causes to which ascites has been attributed may be mentioned exposure to cold or wet; the sudden suppression of habitual discharges, or the rapid cure of chronic cutaneous affections; and extreme anæmia and debility. These causes are supposed to originate this symptom either by inducing active internal congestion; or by disturbing the renal functions; or in consequence of the abnormal state of the blood and tissues. It is very doubtful, however, whether either of them can actually of itself occasion ascites, though they may help in its production. Fluid may collect within the peritoneum as the result of the rupture of a cyst within the abdomen, especially an ovarian cyst.

It must be remembered that ascites may be due to a combination of two or more of the causes which have been indicated in the preceding remarks. For instance, there may be obstruction affecting the portal circulation within the liver and outside this organ at the same time; or the different organs may be involved simultaneously.

Predisposing causes.—Whatever tends to set up either of the morbid conditions which originate ascites, may be regarded as a predisposing cause. It may be met with at any age, but is most common during middle life. The hepatic form is much more frequent in males than females. An anæmic condition of the blood and weakness of the tissues predispose to peritoneal dropsy, as they do to dropsy in other parts.

ANATOMICAL CHARACTERS.—The essential anatomical character of ascites is the accumulation of a serous fluid within the peritoneal sac. Its amount may range from a few ounces to some gallons. As regards physical characters, the fluid is generally thin, limpid, and watery in consistence; colourless or slightly yellow; clear and transparent; and of alkaline reaction. In exceptional instances, however, it may be coloured by blood or bile; or more or less turbid and dirty-looking or milky (chylous); or of unusually thick and somewhat gelatinous consistence. Soft fibrinous masses occasionally float in the fluid, or these may form spontaneously when it is allowed to stand. Very rarely the reaction is neutral or acid. The specific gravity varies considerably. Chemically the fluid consists of water holding in solution albumen and the usual salts which are found in dropsical fluids; but their proportion is very variable, though the albumen is generally in good quantity, which is evidenced by the degree of coagulation which takes place when the fluid is boiled. Occasionally it contains fibrin, cholesterin, bile-elements, or, in cases of renal dropsy, urea.

The effects of the accumulation upon surrounding structures are to distend and macerate them more or less, or to compress them. Of course along with the ascites there will be the signs of any morbid condition upon which it depends; and there may also be indications of anatomical changes resulting from long-continued pressure of the fluid upon certain structures.

SYMPTOMS AND SIGNS.—Ascites usually sets in very gradually, being chronic in its progress, but advancing steadily. Occasionally, however, the fluid collects with considerable rapidity. The clinical phenomena associated with this pathological condition differ in different cases, both in their exact nature and their degree, according to its cause, the amount of fluid collected, and other circumstances; but they may conveniently be considered under the following heads, namely: 1. *Physical signs.* 2. *Mechanical effects of the dropsical accumulation.* 3. *General symptoms.*

1. *Physical signs.*—Physical examination constitutes one of the most important parts of the clinical investigation of cases of ascites, and it will be requisite to discuss in some detail the signs thus recognised.

(*a*) If fluid collects in the peritoneum in any quantity, the abdomen presents more or less general enlargement. This is often the first change which attracts the patient's attention, and it may also have been noticed that the increase in size commenced below. The degree of enlargement depends upon the amount of fluid, but it may become extreme, so that the skin is tightly stretched and thinned, presenting a smooth and shining appearance, or sometimes white lines—*lineæ albicantes*—due to laceration of its deeper layers. The umbilicus becomes affected in a characteristic manner, being more or less stretched and everted, and finally obliterated, or in some cases more or less pouched out, when it may form a considerable prominence. Should there happen to be a weak portion of the abdominal walls, such as a hernial sac, this will be unduly protruded. The important characters of abdominal enlargement, due to uncomplicated ascites, are that it is of a rounded form, though tending to be more prominent or to bulge towards the hypogastric region or in the flanks, according to the posture of the patient; that it is quite symmetrical in shape, when the patient stands or lies on his back, but that the form alters considerably with a change of position, the abdomen becoming then more prominent in the dependent region, in consequence of the gravitation of the fluid in this direction, and it may actually be seen to move as the posture is changed. In contrast with the enlarged abdomen, the chest often looks small and depressed, and the fluid may cause the margin of the ribs to become everted, or it may push forwards the xiphoid cartilage. Mensuration is of service for giving more accurate information as to the size of the abdomen in cases of ascites, and for determining their progress.

(*b*) The abdomen feels perfectly smooth and even over its entire surface. It usually gives a sensation of tension of the walls, without any hardness underneath. In some instances an obscure feeling of fluctuation is experienced on palpation with the fingers.

(*c*) The tendency of ascites is to interfere with the abdominal respiratory movements, if it is at all considerable, by preventing the diaphragm from acting properly. At the same time the writer has not uncommonly observed that, even in cases where the accumulation of fluid has been very considerable, abdominal respiration did not seem to be obviously impeded.

(*d*) *Percussion* affords some of the most important signs of peritoneal dropsy; and when the fluid is present only in small quantity, this is the only mode of examination that can be relied upon for its detection. In the first place, marked dulness is elicited over the seat of the fluid; while a tympanitic sound, which is often abnormally clear and distinct, is heard over the intestines. When there is but little fluid, it may be impossible to detect any abnormal dulness as the patient lies in the recumbent posture; but on placing him on his hands and knees, the fluid gravitates towards the front of the abdomen, and dulness may then be noticed in the umbilical region. In most cases, however, there is no difficulty in making out the dulness, and this sign is observed in those regions towards which the fluid naturally gravitates. Hence, when the patient lies on his back, the lower part and sides of the abdomen are dull, while its upper and front part is tympanitic. As more and more fluid collects, so the dulness increases in extent, gathering in, as it were, from below and from the sides, until finally the entire abdomen may be dull, except the umbilical region, which usually remains tympanitic to the last. The boundary line between the dulness and tympanitic sound is usually well-defined. As the posture is changed, so will the site of the dulness vary, the part which is undermost presenting this sign, while that which becomes highest is tympanitic, and thus the relative situation of these two sounds, as well as the shape of the dulness, can be altered in a variety of ways. When the patient sits up, the prominence between the recti muscles gives a tympanitic sound on percussion. In exceptional instances a distended colon gives rise to a tympanitic sound along each side of the abdomen, even when there is abundant fluid present.

Another important sign brought out by a form of percussion is the sensation specially termed fluctuation, which is the peculiar wave-like movement realised on placing the fingers of one hand over one side of the abdomen, and fillipping or tapping the opposite side with the fingers of the other hand. This sensation is very easily brought out if there is much fluid present, provided it is free to move, and sometimes the motion is actually visible. Change of posture will modify the situation over which fluctuation can be produced.

(*e*) *Auscultation* yields negative results in cases of ascites, there being no sound of any kind heard over the abdomen.

(*f*) In the large majority of cases ascites is clearly revealed by the physical signs already described. In exceptional instances, however, when the diagnosis is obscure, it is requisite to resort to a *digital* examination through the *rectum*, and in females through the *vagina*. The fluid collects in the recto-vesical pouch, and on examination *per rectum* the finger detects the sensation yielded by this fluid through its anterior wall. The vagina is usually felt to be shortened, while the uterus is pushed down and flexed. In extreme cases of ascites the posterior wall of the vagina, or even the uterus itself, may protrude through the vulva.

(*g*) Now and then it is requisite to make use of the aspirator or a small trocar, by the aid of which not only can it be determined whether fluid is present in the abdominal cavity, but its nature can also be ascertained. This method of examination is further useful when ascites is associated with some other morbid condition within the abdomen, which frequently cannot be made out so long as the fluid remains in the peritoneum.

It must be borne in mind that the ordinary physical signs of ascites will be materially modified or obscured under certain circumstances. For example, the quantity of fluid may be so small that most careful examination is required in order to detect its presence; on the other hand, it may be so abundant that dulness is observed over the entire abdomen, and fluctuation may be very indistinct. The existence of peritoneal adhesions—for instance, those which may be formed as the result of repeated paracentesis—also renders some of the most characteristic signs of ascites very ill-defined. Again, the association of peritoneal dropsy with some other abdominal morbid condition, such as a new growth, an enlarged liver or spleen, or an ovarian tumour, will also modify the signs elicited. The mesentery may be abnormally short, or the intestines may be adherent, and thus prevented from floating forwards, so that the usual relative positions of dulness and tympanitic sound are not observed.

2. *Mechanical effects of the dropsical accumulation.*—The clinical phenomena resulting from the mechanical effects of ascites are both subjective and objective. The patient often experiences a feeling of uneasiness and discomfort in the abdomen, as well as more or less tension and fulness, if there is much fluid present; while there may be a sense of fatigue and aching about the loins or abdominal walls. As a rule no particular pain is felt, but colicky pains are liable to occur from time to time, and extreme distension of the structures constituting the abdominal wall may also cause painful sensations. In exceptional instances peritonitis is set up. When the fluid is abundant, the patient is conscious of its weight when he walks; and during progression he throws the head and shoulders back, at the same time keeping the legs apart. Symptoms connected with the alimentary canal are of common occurrence, but these are often to a great extent due to the same cause which originates the ascites, though the fluid must necessarily tend to interfere with the functions of the stomach and intestines. The bowels are usually constipated, but in some instances diarrhœa or dysenteric symptoms may arise. Flatulence is very commonly complained of, even a small amount of gaseous accumulation in the intestines being felt unduly, producing much discomfort, and increasing the enlargement of the abdomen temporarily. Occasionally vomiting occurs, in consequence of interference with the stomach. When considerable fluid has remained in the peritoneum for some time, it presses upon the inferior vena cava and prevents the return of blood through this vessel, and may thus lead to anasarca of both lower extremities, with enlargement of the superficial abdominal veins. Exceptionally the anasarca attracts attention at an early period. The flow of blood through the renal veins may also be obstructed, inducing mechanical congestion of the kidneys, with consequent diminution in the quantity of urine and sometimes albuminuria. In rare instances the fluid has been known to accumulate to such an extent as to rupture some part of the abdominal wall.

Ascites also frequently interferes with the thoracic organs. The bases of the lungs are more or less compressed, and the breathing becomes chiefly upper-costal, while a sense of dyspnœa is experienced, especially in the recumbent posture and after taking food, the breath is short on exertion, and the respirations are often hurried and shallow. The heart is likewise liable to be disturbed in its action, as evidenced by palpitation, irregularity, or a tendency to faintness. This organ may also be displaced, so that its apex-beat is raised and too far towards the left, and in rare instances a basic systolic murmur has been originated as a result of this displacement.

3. *General symptoms.*—The general system is frequently seriously affected in cases in which ascites is a prominent symptom, but this usually depends upon the cause or causes which have originated the dropsy, though it may itself induce more or less debility, wasting, anæmia, and other general effects. The loss of fluid in this way has also been supposed to lead to deficient perspiration, and consequent dryness of the skin; as well as to diminution in the quantity of urine.

Diagnosis.—The first matter bearing upon the diagnosis of ascites is to determine whether this morbid condition actually exists. The presence of fluid in the peritoneum, as well as its amount, can only be positively made out by physical examination, and in the great majority of cases the signs thus elicited are quite characteristic. When the fluid is small in quantity, as well as under other circumstances in which the physical signs are obscured or modified, the diagnosis may be difficult and uncertain, but it may then be aided by a knowledge of the existence of some disease likely to give rise to ascites, of which it is really but a symptom. That the accumulation of fluid is of a dropsical nature, and not due to acute or chronic peritonitis, is usually sufficiently obvious from the history of the case, and the collateral symptoms, while the local signs are also of a different character (*see* PERITONEUM, Diseases of). The remaining abdominal enlargements from which ascites has to be more commonly distinguished are those due to flabby relaxation of the walls of the abdomen, combined with flatulence; accumulation of fat in the subcutaneous tissue and in the omentum; abundant subcutaneous œdema, which may be associated with and obscure ascites; an ovarian cyst; or a pregnant uterus. Among the more rare conditions with which ascites is liable to be confounded may be mentioned a greatly dilated stomach; colloid disease of the omentum; distension of the uterus with fluid; great accumulation of urine in the bladder; a very large hydatid tumour, usually connected with the liver; extreme cystic enlargement of the kidney; and the so-called 'phantom tumour.' Most of these conditions are described in other parts of this work, and their several diagnostic characters need not be discussed here; but a consideration of the history and existing symptoms of each particular case, combined with the results of an adequate physical examination, constitute the data upon which the diagnosis is founded. It must be remembered that ascites may coexist with other morbid conditions in the abdomen, their physical signs being combined. Should there be an enlarged organ or other solid mass, it may often be recognised by making sudden firm pressure with the fingers over the corresponding part of the abdomen, when the fluid is pushed aside, and the underlying resistance can be felt; or paracentesis may be performed, and further examination carried out after the evacuation of the fluid.

Another most important point in the diagnosis of ascites is to make out its cause. For this purpose all the facts bearing upon the case must be taken into account and carefully weighed, special attention being paid to the liver and the structures in its vicinity, to the heart, and to the kidneys. The amount of the ascites, and its relation to other forms of dropsy, afford considerable aid in the diagnosis. If it results from cardiac or renal disease, ascites always follows dropsy in other parts of the body, to which it is also generally subordinate; when it is due to hepatic disease or some neighbouring morbid condition, the peritoneal dropsy appears first, and is, as a rule, throughout most prominent. Should the vena cava inferior be obstructed at its upper part, anasarca of the legs will be observed simultaneously with, or even before, the ascites.

PROGNOSIS.—The prognosis of ascites will mainly depend upon its cause; the amount of fluid present; the state of the patient; the condition of the principal organs; and the results of treatment. In some cases this symptom is in itself attended with urgent danger, on account of the mechanical effects of the dropsical accumulation, especially upon the thoracic organs, and still more if these organs are in a diseased condition. In other instances it tends to reduce the patient, and thus to bring about a fatal termination. When ascites is due to local interference with the portal circulation, great relief can unquestionably be afforded in a considerable number of cases, and life may be prolonged by appropriate treatment; while, if the local cause is not such as in itself to lead to a fatal issue, the ascites may not infrequently be permanently cured.

TREATMENT.—The principles of treatment applicable to cases of ascites are: (*a*) to treat the conditions upon which the dropsy depends, and thus endeavour to get rid of its cause or causes; (*b*) to promote absorption of the fluid; (*c*) to improve the constitutional condition and the state of the blood, if necessary; (*d*) to remove the fluid by operation, if absorption cannot be effected; and (*e*) to treat any symptoms needing special attention.

(*a*) As an important part of the treatment directed to the causes of ascites, particular attention must be paid to the state of those organs which are most commonly accountable for this symptom, though unfortunately but little effect can, as a rule, be produced on the dropsy in this way.

(*b*) Absorption of ascitic fluid is chiefly promoted by acting freely upon the bowels, skin, or kidneys. The class of remedies indicated will vary in different cases, and must be adapted to the state of the different organs; but, as a rule, active hydragogue purgatives are most efficient in relieving ascites, especially when due to local causes. The most useful are compound jalap powder, cream of tartar, elaterium or compound elaterin powder; but calomel, gamboge, resin of podophyllum, and saline purgatives may be of service in particular cases. These agents must, however, be administered with caution. In certain instances balsam or resin of copaiba has proved useful as a diuretic in the treatment of peritoneal dropsy. Assistance may be derived in certain forms of ascites from acting upon the skin by means of various diaphoretic baths. Digitalis and squill may be of service as diuretics; the application of poultices of digitalis leaves over the abdomen is occasionally attended with benefit. The administration of iodide of potassium also seems to aid absorption in some cases, more especially if there be any tendency to syphilitic disease of the liver. It has been recommended to treat ascites merely by a skim-milk diet, without any medicine. Two marked cases were thus treated by the writer with complete success, the fluid being entirely absorbed. In other cases, however, no effect was produced. The employment of galvanism in connexion with the abdominal walls has been found efficacious in producing absorption of peritoneal dropsy in some instances.

(*c*) Treatment directed to the general condition of the patient, and to the state of the blood, is essential in many cases of ascites. Tonics are often of decided service, and preparations of iron are specially indicated for improving the quality of the blood, if there is a tendency to anæmia. Not only do these remedies sustain the patient, but they may also have an influence in promoting the process of absorption. The diet must be adapted to the circumstances of the case, but usually needs to be of a nutritious character.

(*d*) In a considerable proportion of cases, however, no effect is produced upon the dropsical accumulation by any of the measures thus far considered. Then it becomes necessary to determine whether it is desirable to remove the fluid by operation. The fluid may be taken away either by means of the aspirator, by the ordinary trocar and cannula, by Southey's trocars, or by a special apparatus. The advisability of having recourse to this plan of treatment must depend upon circumstances. The ascites is frequently not sufficiently abundant to justify paracentesis, and when the condition is of cardiac or renal origin, the operation can, in the majority of cases, only afford temporary relief, so that there is no object in resorting to it unless the mechanical effects of the accumulation are such as to cause troublesome or dangerous symptoms, and it had better be delayed as long as possible. When ascites is a local dropsy, the fluid is often so considerable in amount as to necessitate its removal for the mere purpose of giving relief for the time. In cases of ascites associated with malignant disease, for instance, this is all that can be hoped for, as the fluid will certainly collect again. When, however, the condition is due to some local disease which is not in itself fatal, and especially to cirrhosis of the liver, the writer has found signal benefit result from the repeated performance of paracentesis, and has for a long period advocated this plan of treatment as a curative measure, so far as the ascites is concerned. Rarely does the operation give rise to any immediate ill-effects, and it is frequently found that remedies will act much more efficiently after the removal of the pressure caused by the fluid than they did previously. In the writer's experience paracentesis, repeated as often as the fluid re-accumulated, has ultimately led to a complete cure in several instances; in others the cure was partial, a certain quantity of fluid remaining in the peritoneum, limited by adhesions; while in others still, life has been greatly prolonged, and much comfort afforded. The repeated accumulation does not seem to affect the system materially by reason of the drain upon it, and frequently not at all. Of course due care must be exercised in the performance of the operation, and in the subsequent treatment. In a few days after the removal of the fluid, the application of a bandage firmly round the abdomen, so as to exert even pressure, may prove of service in aiding the absorption of what remains, and preventing the recurrence of the ascites; and this measure may also be useful when a certain amount of fluid continues after the repeated performance of paracentesis. When the ascites is not cured by repeated tapping, advantage has been found in some instances from allowing the fluid to drain away continuously, and this measure may be worthy of trial.

(*e*) The symptoms resulting from ascites which are likely to require attention are those connected with the alimentary canal; dyspnœa; and cardiac disturbance, or a syncopal tendency. These should be treated on ordinary principles; but it must be observed that marked dyspnœa or cardiac disorder, if evidently due to the fluid, is an indication for the immediate performance of paracentesis.

FREDERICK T. ROBERTS.

ASHEVILLE, in North Carolina.—Situated between the Blue Ridge and Alleghany Mountains, in 35° 36′ N. lat., 2,250 feet above the sea. A mild winter and cool summer climate; of repute in the treatment of phthisis. Temperatures: summer, 70·7°; winter, minimum has never fallen below 8° Fah.; range 80°. Rainfall, 40 inches. Possesses a sanatorium. *See* CLIMATE, Treatment of Disease by.

ASIATIC CHOLERA.—*See* CHOLERA, ASIATIC.

ASPHYXIA (ἀ, priv.; and σφύξις, pulse).—SYNON.: Apnœa; Fr. *Asphyxie*; Ger. *Erstickung.*

DEFINITION.—The term *asphyxia*, though literally signifying *pulselessness*, is generally understood to mean the condition that supervenes on interruption of the function of respiration. The term *apnœa*, preferred by many as a more exact one, has the disadvantage of being employed by physiologists in a totally different sense, viz. the cessation of the respiratory movements consequent on artificial hyperoxygenation of the blood. There is therefore no advantage to be gained by substituting the term apnœa for the well-understood and older one, asphyxia.

ÆTIOLOGY.—Asphyxia may result from many causes which obstruct or interrupt the respiration. They may be divided into two categories, internal and external.

Internal.—These include paralysis of the respiratory nerve-centres by disease or injury of the medulla oblongata; paralysis of the nerves or muscles of respiration; a rigid fixation of the respiratory muscles; collapse or disease of the lungs; occlusion of the air-passages by organic disease or spasm of the glottis, pressure of tumours, and the like.

External.—To this group belong occlusion of the air-passages by foreign bodies; pressure on the chest not capable of being overcome by the muscles of respiration; closure of, or external pressure on, the air-passages, as in suffocation, strangulation, or hanging. These are all cases of obstruction of the respiratory movements in a medium capable of supporting life. To these external causes are to be added those conditions in which, though the respiratory movements are free, the surrounding medium is incapable of oxygenating the blood, viz., submersion in a liquid medium (drowning); or being surrounded by a medium devoid of oxygen, such as nitrogen or hydrogen. These gases have a purely negative effect; but many other gases which are classed as asphyxiants, such as carbonic oxide, sulphuretted hydrogen, chlorine, chloroform vapour, &c., have positive poisonous effects, and should therefore be called by some special name, such as *toxic asphyxiants*, to distinguish them from those which have no such properties.

Phenomena.—When an animal is placed in an atmosphere devoid of oxygen, or not containing a sufficient quantity of this gas (under 10 per cent.) to maintain the respiratory process, or if the mechanism of respiration is simply obstructed, it begins to show signs of agitation, and to make powerful inspiratory and expiratory efforts, in which the accessory muscles of respiration are all brought into action; the arterial tension increases; and the superficial veins become distended and livid.

After a variable period these dyspnœic efforts pass into general convulsions, in which the muscles of expiration are more especially in action, during which the sphincters are forced, and the excretions voided. On these there follows a calm, during which the animal lies insensible, with dilated and immovable pupils, and with reflex excitability abolished generally. At the same time the pulse is small, feeble, and almost imperceptible. All muscular movements cease except those of inspiration, which are repeated at intervals. As death approaches, the respiratory movements become shallower and less regular, and are succeeded by stretching convulsions, during which the back is straightened, the head is thrown back, the mouth gapes, and the nostrils dilate. The heart still continues to beat after other movements have ceased. The heart ultimately stops in the state of diastole. Death is then complete and final.

Course and Termination.—The time necessary to bring about a fatal termination varies in different animals, and in the same animal under different conditions. It has been noted that the young of some animals resist asphyxia longer than the adults. The late M. Paul Bert has shown that these differences are all explicable in accordance with the law that the more active the vital combustion, the greater the gaseous interchange, and therefore the more rapidly fatal the obstruction of the respiratory process. Excluding special considerations of this kind, it may be stated, as the result of the experiments of the Medical and Chirurgical Committee on Suspended Animation (*Med.-Chir. Trans.* vol. xlv. 1862), that when the respiration of a warm-blooded animal is totally obstructed, all external movements cease in from three to five minutes, and the heart stops within ten minutes. Certain modifications occur according to the method in which asphyxia is produced. *See* Drowning.

Anatomical Characters.—The blood is of a dark colour, owing to complete reduction of the hæmoglobin, and the proportion of carbonic acid is greatly increased. Owing to the excess of carbonic acid, the blood coagulates slowly or imperfectly; hence it remains long fluid, or forms few and soft coagula. The venous side of the heart, the great venous trunks, and the pulmonary artery are distended with dark blood; whilst the left side is empty, or contains only a small quantity of dark blood.

The appearance of the lungs is not constant. These organs are by no means always congested, as is very generally stated, being more often pale and anæmic. The posterior and dependent parts become hypostatically congested *post mortem.* The abdominal viscera are usually congested. The appearance of the brain varies, this organ being either anæmic or more or less congested. Special signs characterise special modes of causation of asphyxia.

Pathology.—Inasmuch as the cessation of respiration means both oxygen-starvation and accumulation of carbonic acid, the question is whether the phenomena of asphyxia depend on the one or the other, or on both. Various opinions have been entertained on this subject, but the experiments of Rosenthal and Pflüger would seem to show that the deprivation of oxygen is the chief factor. That the accumulation of carbonic acid has no effect at all cannot, however, be maintained, for it is demonstrable that carbonic acid has a distinct toxic effect on living tissues.

The circulation of non-oxygenated blood through the lungs and the respiratory centre in the medulla oblongata is the cause of the powerful respiratory efforts in the first stage—directly, by stimulation of the respiratory nerve-centres; indirectly, by peripheral irritation of the pulmonary branches of the vagi. The respiratory movements increase in force, and the irritation irradiates into the centres of other movements besides those directly concerned in respiration, giving rise to the expiratory convulsions which have been ascribed by some to excitation of a special 'convulsion-centre' (*Krampfcentrum*).

The respiratory centres ultimately become paralysed, but subsequently to those of conscious activity—the brain; and of reflex action—the spinal cord.

The circulation of non-oxygenated blood likewise causes contraction of the arterioles from irritation of the vaso-motor centre. Increased resistance is thus offered to the heart, and this is intensified by the convulsive muscular efforts. The arterial tension rises. The resistance to the flow through the capillaries by contraction of the minute blood-vessels occurs not only in the systemic, but also in the pulmonary circulation at an appreciable period after its occurrence in the systemic vessels. The ventricles become distended, and the heart's action laboured. The heart becomes enfeebled by the circulation of non-oxygenated blood in its walls, the diastolic intervals become longer, until the organ finally stops in a state of diastole, with the right side full, while the left may have succeeded in emptying itself. Owing to the obstruction of the pulmonary circulation from this cause, the systemic blood-pressure falls, and the pulse becomes small and feeble.

Treatment.—Resuscitation from pure asphyxia is possible so long as the heart continues to beat. After cessation of the heart's action treatment is unavailing, except in cases of cessation from mere over-distension, in which bleeding from the external jugular vein may be resorted to with success. The chief indication in the treatment of asphyxia is to effect oxygenation of the blood by the introduction of air into the lungs. If the medium by which the patient is surrounded is incapable of supporting respiration, he must be immediately removed, or the atmosphere changed. If the air-passage is obstructed by a foreign body, this must be extracted; if this is impossible, or if the obstruction result from disease, tracheotomy or laryngotomy must be resorted to. Means must be adopted of exciting the respiratory centres or respiratory muscles to action; or if these are paralysed and non-excitable, the natural movements of respiration must be imitated artificially, or air introduced by insufflation.

The respiratory centres, if not absolutely paralysed, may be excited reflexly by stimulation of cutaneous nerves, especially those of the face and thorax. This may be effected by the stimulus of sudden cold, or better by alternate dashing of hot and cold water on the face and chest, or by flicking the skin with a towel. These reflex stimuli are often of themselves sufficient to excite respiratory movements; if not, they are powerful subsidiary aids to artificial respiration. The diaphragm may be stimulated to contraction by galvanisation of the phrenic nerve, one pole being placed on the nerve as it crosses the scalenus anticus at the root of the neck, the other on the epigastrium. Chief reliance, however, is to be placed on the methods of *artificial respiration*, which, after all, are the most simple and the most effectual, and possessed of the pre-eminent advantage of being always available. *See* Artificial Respiration.

Air may also be introduced into the lungs directly by properly constructed *insufflation-apparatus*, either by the insertion of a tube within the larynx (an operation requiring dexterity, but without danger if skilfully performed, though there is always risk of rupture of the air-vesicles from over-distension); or more easily by the insertion of the tube in one nostril, the other nostril and the mouth being closed (Richardson's apparatus). *Mouth-to-mouth-insufflation* is sometimes of advantage, especially in infants. The operator must close the nostrils of the patient, and, applying his mouth directly to that of the patient, inflate the lungs by his own expiratory efforts. The tendency to inflation of the stomach is considerably counteracted by backward pressure on the larynx.

D. Ferrier.

ASPHYXIA, Local.—A synonym for Raynaud's Disease. *See* Raynaud's Disease.

ASPIRATOR.—Synon.: Fr. *Aspirateur*. The operation of pneumatic aspiration was introduced into practice by Dieulafoy in 1869. Before this period various instruments had been used under the name of 'suction-trocars,' but to Dieulafoy is due the credit of fully appreciating their value.

Description and Mode of Employment. The aspirator consists of a glass syringe, having at its lower end two openings provided with stopcocks. When the piston is raised and the cocks are closed, a vacuum is created in the syringe, which can be maintained by fixing the piston in the withdrawn position. An india-rubber tube is fitted into each of the two openings, and these must be provided with coils of wire inside to prevent them from collapsing. At the end of one tube is fixed a fine hollow needle. The needle should have only one opening, at the point, and not, as is often seen, another at some distance from it. The instrument is thus used:—A vacuum having been created in the syringe by raising the piston whilst both stopcocks are closed, the needle is introduced into the part to be operated upon. As soon as the opening of the needle is beneath the skin the stopcock leading to it must be opened. The vacuum will then extend to the point of the needle; and consequently, if it be gently pushed onwards, the moment it encounters fluid this will jet up into the glass syringe, when its nature may be ascertained. This mode of operating with what Dieulafoy calls the 'previous vacuum' is the essential difference between aspiration and suction. In aspiration it is impossible to pass the needle through a collection of fluid without discovering it; whereas without the 'previous vacuum' in the needle this might readily be done. If the fluid is sufficient in amount to fill the syringe, the stop-cock leading to the needle is to be closed and the other opened, by which the fluid may be discharged. The vacuum may then be re-established, and the operation repeated as often as is necessary. By opening both stopcocks at once and allowing the discharge-tube to hang down, the aspirator may be converted into a syphon. The action of the instrument may also be reversed, and it may be employed for injecting fluids. Other varieties of aspirator are in use besides the one above described. In Weiss's the receiver is a glass bottle, from which the air is exhausted by means of a separate exhausting syringe. The objection to this is that if the needle becomes choked, it cannot be cleared by pushing down the piston and driving some of the fluid back through it. Other kinds of aspirator cannot be converted into syphons, and these are objectionable. Weiss's has the advantage of being less liable to get out of order, as the fluid does not touch the exhausting syringe. The needles employed vary in size. Dieulafoy recommends that they should be about $\frac{1}{50}$, $\frac{1}{25}$, $\frac{1}{20}$, and $\frac{1}{12}$ of an inch in diameter, and calls them Nos. 1, 2, 3, and 4 respectively. The aspirator may also be applied to trocars, but then its distinctive feature is gone, and it becomes but a 'suction trocar.'

The following rules must always be observed in using the aspirator:—1st. See that the needle is pervious and clean and the syringe in order before using it. It is advisable to wash the needle and syringe well in strong carbolic acid solution. 2nd. The needle must be pushed straight on in one direction only. Its course should not be altered while the point is under the skin. If no fluid is found, it may be withdrawn and reinserted. It must be held as steady as possible during the aspiration. 3rd. If the fluid will not flow with the pressure of the atmosphere, it is of no use squeezing and pressing the part. This can only do harm. 4th. Aspiration must cease at once when blood comes in any quantity, especially in abscesses. 5th. Keep up the vacuum during the withdrawal of the needle, lest some of the morbid fluid be left in its track. 6th. If the needle becomes choked, force a little of the fluid back through it in order to clear it. 7th. After use the whole apparatus must be thoroughly cleaned with plain water to completely remove pus, blood, and other albuminous fluids, which would be coagulated by carbolic acid. After this is thoroughly done, the needle, tubes, and syringe should be disinfected with carbolic lotion (1 in 20). The leather of the piston may be greased with carbolised oil or vaseline.

Uses.—Aspiration is used for purposes of diagnosis and treatment. Dieulafoy asserts that with the No. 1 needle it is possible to search for fluid without danger, whatever may be its seat or its nature; and experience has proved this to be practically true. In treatment it has been employed in the following affections:—

Abscesses.—In acute abscesses simple aspiration is usually of little value, as the pus soon re-accumulates. In chronic abscesses connected with diseased bone it usually fails; and often it is impossible, from the presence of cheesy matter in the pus. If performed with proper antiseptic precautions, however, it can do no harm, and may, if repeated, diminish the size of the sac before other means are adopted, or even effect a cure. A modification of simple aspiration has been recently introduced by Billroth, which not infrequently cures even chronic abscesses undoubtedly connected with diseased bone. Instead of the small needle, a large trocar, from $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter, is fitted to the aspirator. If necessary a small incision is made in the skin to facilitate the introduction of the trocar. The abscess having been emptied of its contents, the cavity is distended with a solution of perchloride of mercury (1 in 4,000) which is again withdrawn by the aspirator. This must be repeated again and again, till the fluid returns perfectly clear. Finally, an emulsion of iodoform and glycerine (1 to 10) is injected, the trocar is withdrawn, and the opening sealed with collodion. Most commonly the abscess fills again in a few days, after which the fluid may be gradually absorbed, but it is frequently necessary to repeat the operation more than once. There is no doubt that many chronic abscesses have been cured in this way, but the exact value of the treatment has yet to be determined. *Diseases of the Liver.*—Hydatid cysts have been successfully treated by aspiration. In many cases the fluid becomes purulent after one or two aspirations, and in some the cyst has opened externally. For purposes of diagnosis the small needles may always safely be introduced into the liver. Abscess of the liver has been successfully treated by the aspirator. *Retention of Urine* may be safely relieved by using No. 2 needle above the pubes. *Ovarian cysts* may be diagnosed and treated in the same way. *Hernia.*—It has been asserted that strangulated hernia may be, in the great majority of cases, relieved by the use of the aspirator. The finest needles only should be used. They remove first the fluid from the sac, after which some gas may be obtained from the strangulated gut, but fæcal matter rarely fails to choke the tube. Experience has, however, shown that this mode of treatment is both dangerous and inefficient. *Diseases of Joints.*—Aspiration is occasionally useful in acute synovitis. Great care must be taken not to scratch the inside of the joint with the needle, as this has been said to lead to acute arthritis and suppuration. No. 1 or 2 needle should be used. *Hydrocephalus* and *Spina bifida* may be aspirated with safety with No. 1 needle. In hydrocephalus it is to be passed through the anterior fontanelle. No case has hitherto been cured by this treatment. In *Pleurisy* and *Ascites*, except for purposes of diagnosis, in the writer's opinion the aspirator presents no advantages over a trocar properly constructed so as to exclude air (*see* PARACENTESIS). *Pericarditis.*—The operation of aspiration has frequently been successfully performed for pericardial effusion. It is thus carried out:—A spot is chosen 2 to 2⅓ in. (5 or 6 centimetres) beyond the left edge of the sternum, in the 4th or 5th interspace. No. 2 needle is then passed obliquely upwards and inwards, taking care to turn on the vacuum as soon as the eye is covered. The moment the fluid jets into the syringe the needle must be held steadily till the flow ceases. If this be done there is no danger of wounding the heart. If there is any doubt as to the existence of fluid, No. 1 needle must be employed, with which the heart may be punctured without great danger.

MARCUS BECK.

ASTHENIA
ASTHENIC (ἀ, priv.; and σθένος, strength).—Terms signifying want of strength. As applied to the entire system, they indicate considerable general debility; in connexion with particular diseases, they imply that these are attended with marked weakness. *See* DEBILITY.

ASTHENOPIA (ἀ, priv.; σθένος, strength; and ὤψ, the eye).—Weakness of sight. *See* VISION, Disorders of.

ASTHMA, SPASMODIC (ἆσθμα; from ἄω, I blow).—SYNON.: Bronchial Asthma; Fr. *Asthme*; Ger. *Bronchial-Asthma*.

DEFINITION.—An affection characterised by severe paroxysmal dyspnœa, recurring at more or less well-marked periods, generally in the night, the dyspnœa being due to spasmodic contraction of the bronchi, produced by a variety of causes.

ÆTIOLOGY.—The causes that induce an attack of asthma are very various, and may be roughly classed according to their action, *direct* or *indirect*, on the respiratory organs. In the former class the exciting cause immediately affects the mucous membrane; in the latter it does so in a more circuitous manner, as through the blood or the nervous system generally:—

- Direct
  - Dust.
  - Vegetable irritants.
  - Chemical vapours.
  - Animal emanations.
  - Climatic influences.
  - Bronchial inflammation.
- Indirect
  - Through the nervous system
    - Centric.
    - Excito-motor.
  - Through the blood
    - Gout.
    - Syphilis.
    - Skin-diseases.
    - Renal diseases.
  - Heredity.

Direct causes.—Common roadside dust; fluff from woollen clothing; the dust of mills, threshing-floors, or bakehouses; and any mechanical particles when inspired, will produce in some persons an asthmatic seizure; dust of low specific gravity being more apt to have this effect than heavy particles like coal, steel filings, &c., from which arise lesions in the lung of a more permanent and serious character.

The odour evolved by certain vegetables, such as ipecacuanha; the pollen of many grasses and plants (*see* HAY-FEVER); certain chemical vapours, as that of pitch, sulphurous acid, and phosphorus fumes; the peculiar smell of some animals, as dogs, cats, horses, and hares, may each provoke a spasm in individual cases.

A still more powerful cause is climatic influence, the action of which on different patients cannot, unfortunately, be reduced within the limits of a law, but depends mainly on the idiosyncrasy of the individual. Extremes of temperature, or excessive dryness or dampness, may produce an asthmatic seizure, but in the largest number of cases one of two elements appears as the chief factor. One large class of sufferers trace the attack to *dampness*, whether of soil or of atmosphere, in combination with either heat or cold; another to *closeness* of atmosphere and a want of proper circulation of air, such as is found in deep valleys and thick forests, and during thundery weather—this last class experiencing great relief when a breeze springs up. Malaria plays an important part occasionally in the causation of asthma.

Far more general and intelligible in its action is bronchial inflammation, which is the cause in 80 per cent. of asthmatic cases. It frequently happens that after whooping-cough, measles, or infantile bronchitis the tendency towards asthma begins to appear. These diseases, implicating as they do both bronchial muscle and nerve supplying it, leave their mark behind, either in irritability of the mucous membrane; in induration of some portion of the lung, generally at the root; or in enlargement of the bronchial glands, causing pressure on the pneumogastrics, or on some of the branches of the pulmonary plexuses (*see* Bronchial Glands, Diseases of); and thus lay the foundation of asthma in after-life. Asthma following on arrested phthisis is not rare in adults, probably from enlargement of the bronchial glands by absorption of tubercle and caseous material. In other instances the indirect cause may be found in morbid states of the nose or throat.

Indirect causes. — This class of causes includes those acting through the general nervous system; those acting through the blood; as well as the more or less structural one of heredity.

The *centric* subdivision embraces attacks arising from emotion, anger, or fright; as well as the curious alternations of asthma, neuralgia, angina, and gastralgia due to some centric irritation in the medulla, involving the origins of the fifth and eighth pairs of nerves, and manifesting itself by affecting first one branch and then another of these nerves.

Excito-motor causes may be illustrated by indigestion or costive bowels giving rise to a paroxysm of asthma. In the first case, irritation of the medulla is induced through the gastric branches of the pneumogastric, and a motor effect is reflected through the pulmonary branches. These *peptic* attacks, as they are called, occur more frequently after suppers than dinners, probably because reflex irritability is always exalted by sleep, as we know to be the case in epilepsy and the teething convulsions of childhood.

Gout, towards old age, often takes the form of asthmatic seizures, which alternate with the articular affections. In like manner attacks of the disease have been attributed to syphilis, but here the poison generally acts by enlarging the bronchial glands.

The connexion between asthma and various kinds of skin-disease is intimate: the subsidence of eczema, of urticaria, or of psoriasis, has often been accompanied by fits of spasmodic breathing, which have ceased on the reappearance of the eruptions. Here, again, the state of the blood is presumed to be the origin of both maladies, as in disease of the kidneys, which will be presently referred to.

Heredity can be traced in about 40 per cent. of asthmatics, though the tendency often does not show itself till late in life. The characteristic form of chest is frequently transmitted from parents to children; and even when this is not so, a disposition towards spasmodic symptoms in catarrhal attacks is often seen in the children of some asthmatics.

Symptoms.—The patient may retire to bed with few or no premonitory symptoms, and sleep for some hours, but is disturbed in the late night or early morning—2 a.m. is a common time—by a feeling of oppression approaching to suffocation, referred either to the throat, sternum, or epigastrium, which obliges him to sit up in order to breathe. Sometimes the onset is more gradual: the patient, having fallen asleep in spite of uneasy sensations, begins to wheeze during sleep, and is only aroused when the dyspnœa becomes severe. The breathing is accompanied by a humming sound, which gradually develops into a great variety of discordant noises.

In order to increase the capacity of his chest to the utmost, the asthmatic patient sits up and fixes his shoulders, either by placing his hands on either side of him, or by supporting his elbows on his knees; or sometimes he stands leaning over the back of a chair or other support. In one or other of these positions he remains immovable, with chest, back, shoulders, and head fixed; unable to speak or even to move his head; the lips being parted; the face pale, anxious, and, if the dyspnœa continue, livid; and the eyes prominent and watery. Every muscle of respiration, ordinary and extraordinary, is brought into requisition; those passing from the head to the shoulders, to the clavicles, and to the ribs become rigid, and, in place of moving the head and neck, act the reverse way, being used from fixed points to raise and dilate the thorax. The trapezii and levatores anguli scapulæ by their contraction elevate the shoulders, in order that the muscles connecting these with the ribs may act as elevators to the latter. Even the muscles of the back are pressed into the service, and they almost cease to support the back; consequently the patient stoops. At each inspiration the sterno-cleido-mastoids stand out like cords, leaving a deep hollow between their sternal attachments; the diaphragm is contracted, and hence the stomach, liver, and heart are somewhat displaced. With all this display of muscular force, the chest remains almost motionless, being expanded to a variable extent.

In spite of the great dyspnœa, respirations are not proportionately frequent, seldom exceeding thirty, and sometimes falling to nine a minute. The expiration is prolonged, being generally two or three times as long as the inspiration. The pulse is usually slow and feeble; the temperature rarely exceeds 99° Fah., and is often below 98° Fah. Analysis of the expired air shows the oxygen to be almost entirely replaced by carbonic acid, which may increase from the normal to as much as 11 per cent., the nitrogen varying from 89 to 93 per cent. The arrest of expiration is probably the cause of the accumulated carbonic acid, but the total disappearance of the oxygen is hardly to be explained, for that oxidation of the tissues does not proceed is shown by the pale urine passed after the fit.

Physical Signs.—These reveal less than might be expected. The percussion-note is somewhat raised over the whole chest, most so in the posterior regions, where a drum-like sound occasionally prevails; this hyper-resonance is probably due to accumulation of air induced by obstructed expiration, and in incipient cases passes off with the attack. The normal areas of cardiac and hepatic dulness often disappear during the attack, owing to the emphysema temporarily induced. When the attack has passed off, careful examination will sometimes detect dulness in the supra-scapular or inter-scapular regions, on one or both sides of the chest, indicating probable enlargement of the bronchial glands.

Auscultation shows an entire abolition of the normal breath-sounds, and the existence of dry sibilant or sonorous rhonchi, everywhere varying in tone according to the calibre of the bronchial tubes; the smaller tubes giving the high notes, and the larger ones the deep notes. These sounds continually change their position, springing up under the listening ear, and as quickly vanishing again, to give place to profound silence.

Progress and Duration.—A paroxysm of asthma, when once established, lasts from half an hour to several days, and generally terminates with expectoration—thin and transparent if the seizure be short; but abundant and more or less opaque if the fit be prolonged, or if the case be chronic. The sputum has also been found to contain, in greatest abundance at the close of the attack, (1) the so-called Charcot-Leyden crystals, which are minute octahedra of unknown composition, but soluble in warm water; also (2) Curschmann's spirals, which consist of closely packed epithelial cells, arranged in a spiral form surrounded by mucoid material. These are not, however, pathognomonic of asthma. The urine is light-coloured and plentiful; the surface is bathed with perspiration; and flatus is often expelled from the bowels. Little or no food is taken during the attack, at the close of which the patient falls asleep.

The recurrence of the attacks when once they have been excited is generally periodic; but much depends on the presence or absence of the exciting cause. In many cases the patient is quite free from wheezing and dyspnœa in the intervals, and feels and acts like other people; but when the attacks follow each other closely, a more or less wheezy condition remains behind, and a few signs of obstructed breathing are generally to be detected in the interscapular regions.

Complications and Sequelæ.—If the asthmatic attacks become habitual, their effects are seen on the patient's frame and on the organs implicated. The shoulders become raised, the head being buried between them; the muscles of the back, owing to their being called on to act as extraordinary muscles of respiration, are diverted from their use as erectors of the spine, which, accordingly, yields in the anterior direction, and the patient stoops. The frequent occurrence of spasmodic contraction of the bronchi causes hypertrophy of their muscular coat; and this, with or without the congestion of the mucous membrane accompanying it, leads in time to thickening of the tubes and permanent narrowing of their calibre. The more common result of asthma is emphysema, arising from the difficulty of expiration. The emphysema, at first temporary, becomes in chronic cases permanent, and gives rise to displacement of the adjoining organs (*see* Emphysema). Contraction of the bronchi largely influences the pulmonary vessels, and considerable obstruction of the pulmonary circulation is the result. The vessels become gorged, and the lungs sometimes œdematous. If the emphysema be extensive, we may in time expect dilatation of the right side of the heart and marked prominence of the veins of the breast and neck, and the effects may be carried so far as to cause œdema of the lower extremities with albuminous urine, as the writer witnessed in a case where these symptoms disappeared on the subsidence of the asthma.

Pathology.—Patients rarely, if ever, die of spasmodic asthma, though death may ensue from some of its complications and sequelæ; and the disease, being a functional one, cannot be said to have any morbid anatomy. The onset and departure of the attack, and the ever-changing physical signs, led Laennec to think that, whatever obstruction in the bronchial tubes caused the phenomena, must be of a spasmodic and transitory nature. He therefore concluded that asthma was due to a spasm of the bronchial muscles which had been described by Reisseissen. Laennec also showed that an asthmatic sufferer could sometimes, after holding his breath, actually breathe naturally for one or two respirations, thus clearly demonstrating that the spasm was capable of momentary relaxation. Other theories were put forward, and doubt was thrown on the existence of muscular fibres in the bronchi, until Dr. C. J. B. Williams proved their existence by his experiments on the lungs of oxen, dogs, rabbits, and other animals, when he caused contraction of the trachea and bronchial tubes by the application of electrical, chemical, and mechanical stimuli. The muscular coat was shown to be more abundant in the smaller tubes than in the larger, the former contracting sufficiently to entirely obliterate their passages. In asthma, excitation of the muscles probably takes place through the anterior and posterior pulmonary plexuses, which are made up of branches from the pneumogastrics, recurrent laryngeals, the spinal nerves, and the ganglia of the sympathetic, thus giving the bronchial tubes a very wide area of connexions. The branches of the pulmonary plexus form a network round the bronchial tubes, and contain some minute ganglia. When the cause is direct, as dust of any kind or climatic influence, the spasm may be induced by reflex action through these small ganglia, or through the pulmonary plexus, though it soon extends deeper into the nervous system, involving the pneumogastrics, and causing a motor effect on the thoracic muscles through the upper cervical, phrenic, and dorsal nerves. Where emotion, fright, or laughter starts the fit, the irritation is centric, and causes a motor effect on the pulmonary plexus through the pneumogastrics. Where, again, indigestion excites it, the sensation passes through the gastric branches of the pneumogastric, and is reflected by the motor filaments of the pulmonary plexus. Lastly, where gout, syphilis, albuminuria, skin-disease, and heredity are the excitants, we may regard the blood itself as causing the local irritation. Spasmodic asthma may, therefore, be considered as a neurosis of the pulmonary branches of the plexus of that name, similar to other neuroses, as hemicrania and sciatica, and giving rise, through the motor nerves of the plexus, to spasm of the bronchial muscle.

Diagnosis.—Asthma is distinguished from *bronchitis* by the fugitive physical signs; by the spasmodic character of the dyspnœa; and by the scant expectoration. The breathing in bronchitis, when at all difficult, is hurried; in asthma it is slow, wheezy, and prolonged; this feature also contrasting strongly with the gasping, panting dyspnœa generally accompanying pneumonia, pleurisy, and some forms of heart-disease. From *croup* it is recognised partially, but not entirely, by the age of the patient; and partly by the character of the dyspnœa, which in croup is inspiratory, whereas in asthma it is mainly expiratory. This characteristic also distinguishes asthma from spasm of the glottis and the various forms of laryngeal dyspnœa. The diagnosis from *emphysema*, which is so often mixed up with spasmodic asthma, is founded chiefly on the paroxysmal character and violence of the asthmatic dyspnœa, and on the complete freedom of the intervals, the dyspnœa of emphysema being more or less permanent.

Aneurysm of the aorta and other *mediastinal tumours* often give rise to symptoms so exactly simulating spasmodic asthma as to make the diagnosis difficult, and this is to be accounted for by these tumours pressing on the pneumogastric and its branches, and thus inducing an asthmatic spasm. These cases are, as a rule, however, accompanied by a certain amount of stridor arising from laryngeal spasm, not present in asthma, and this symptom is often of great diagnostic value in obscure cases. As the tumour enlarges, it causes greater pressure on the lungs, trachea, œsophagus, sympathetic ganglia, or other structures, and produces shrill cough, dysphagia, difficulty of inspiration, pain in the chest, impulse in the thoracic wall, and other noted aneurysmal symptoms. Moreover, certain physical signs become evident, *e.g.* dulness over the first portion of the sternum or to the right of it, or between the scapulæ; tubular sounds and bronchophony close to the sternum, or above one or both scapulæ; or some form of bruit or murmur in the course of the aorta. These and other symptoms and signs contrast sufficiently with those of spasmodic asthma, to make the diagnosis from developed aneurysm comparatively easy.

In some cases of *renal disease* in which albumin appears in the urine, a form of dyspnœa appears, which is occasionally marked by paroxysmal features, and has been mistaken for spasmodic asthma. Renal dyspnœa differs, however, as a rule, in being more continuous; and in having for its origin œdema of the lung rather than bronchial spasm. *See* Respiration, Disorders of.

Prognosis.—The question of recovery in cases of asthma depends, to a certain extent: first, on the possibility of the removal of the exciting cause; secondly, on the age of the patient; thirdly, on whether the attacks increase or not in frequency; fourthly, on the condition of the lungs and the breathing in the intervals.

If the patient be young (say, under fifteen), the chest well-formed, the attacks tending to diminish in frequency and intensity, and the lungs free in the interval, a most hopeful prognosis can be given. If, on the other hand, the patient be middle-aged, the attacks increasing in number and severity, and the breathing more or less short in the intervals, we may conclude that there exists a considerable amount of permanent emphysema, which renders the prognosis of an unfavourable character. In every instance the detection and removal of the exciting cause or causes, as the case may be, exercise a chief influence over the prognosis.

Treatment.—The principal difficulty in the treatment of asthma lies in clearly ascertaining the nature and origin of the exciting cause. When this is discovered two great principles should guide us, namely: first, to avoid or remove the exciting cause; secondly, to allay and prevent the spasm.

Many of the cases arising from direct causes, as from dust and chemical vapours, are cured by simple avoidance of the exciting cause. Where bronchial inflammation induces the spasm, the inflammation must be subdued by salines and expectorants, combined with some anti-spasmodic, as belladonna, henbane, or stramonium. In more chronic instances, where some thickening of the walls of the larger bronchi and enlargement of the bronchial glands exist, iodide of potassium in doses of grs. v. to xv., or iodide of sodium in doses of gr. v., or a combination of both iodides, has been found very beneficial when persisted in for long periods. Symptoms of iodism may be generally averted by temporarily diminishing the dose and diluting more largely with water. Inunction of preparations of iodine, such as the linimentum potassii iodidi c. sapone, or the unguentum potassii iodidi, or painting the skin with iodine-tincture, have not proved so successful in the writer's hands. The waters of Woodhall and Purton in England, of Kreuznach in Germany, and of Saxon in Switzerland, contain iodides largely diluted, and may be beneficially administered in asthma. Affections of the nose or throat will require attention. Where the attacks depend on gout, syphilis, or renal disease, or are connected with skin-disease, treatment must be directed to the condition of the blood. Arsenic proves of signal service in asthma co-existing with eczema, psoriasis, or other skin-affections.

Where heredity is the predisposing cause, the origin of the disease lies generally in defective development of the frame or of the lung-structure of the patient. For such persons gymnastic exercises, carefully conducted swinging on the trapeze, and other means of expanding the upper part of the chest and correcting the asthmatic stoop are to be employed, combined with tepid or cold sponging and as much outdoor life as possible, with walking and riding without fatigue. The tendency to catarrh is thus lessened, and the frame of the patient developed and fortified. In a large number of cases—as, for instance, those arising from climatic influences—we have to treat a simple neurosis, and to allay the spasm either by climatic or by medicinal means, of which the former is often the more important, and, owing to the leading part played by the idiosyncrasy of the patient, generally the most difficult. In obstinate cases the doctrine of contrasts appears the only safe one. Where the disease has been contracted in a moist climate, a dry one must be tried; if in an inland district, the seaside must be resorted to; but for by far the majority of asthmatics the atmosphere of large towns is suitable, and the smokier the air and the closer the streets the more good do the sufferers appear to receive. London, Glasgow, Birmingham, and Bristol are all favourable resorts for cases of neurotic asthma; and the points of difference between their atmospheres and that of the country consist, (1) in dryness; (2) in deficiency of oxygen; and (3) in excess of carbonic acid and carbon: all of which peculiarities appear to exercise a sedative effect on the neurosis. Damp, whether of soil or atmosphere, is usually found to be hurtful, and is one of the chief exciting causes of asthma. Nothing exemplifies this more completely than the excellent results in cases of asthma produced by climates of which the atmosphere is dry.

The *medicines* most useful in asthma are antispasmodics, either stimulant or sedative. The former, including alcohol, strong coffee, nitro-glycerine, ether, and nitrite of amyl, will prove more efficacious where emphysema is present; the sedative comprise stramonium, belladonna, Indian hemp, lobelia, datura tatula, tobacco, opium with its alkaloids, and drugs of a similar action. These may be taken internally in the form of extracts or tinctures; or smoked in pipes or as cigarettes; or inhaled as vapour diffused through the room by burning powders or pastilles containing them. A popular and often reliable remedy is the vapour arising from the combustion of nitre-paper, and other useful forms of powder may be devised; but these should be recommended with caution, lest an unfortunate habit of indulgence in fuming preparations be acquired. In the severest attacks the patient can neither smoke nor swallow, and in this difficulty of introducing medicines into his system we find the hypodermic injection of atropine (gr. $\frac{1}{60}$), morphine (gr. $\frac{1}{4}$–$\frac{1}{3}$), and chloral, or suppositories of morphine and belladonna *per rectum*, prove effectual; but if albuminuria or emphysema be present, or if the pulse be weak, they must not be used. Chloroform often acts like a charm in the worst case, and after inhaling 20 to 60 minims the patient will gain the sleep which has been denied to him for hours, or even days; but as the effect is generally transitory, and the use of the remedy not free from risk, it should be given, if at all, in capsules containing a measured dose. Iodide of ethyl (♏ v–x.) can be inhaled with advantage. Ether is safer, but not so effective. Chloral hydrate in doses of 15 to 20 grs., repeated every four hours until the spasm subsides, has produced not only temporary, but even permanent good in a large number of asthmatic cases, and, if watched, may be persisted in for some time. In the writer's hands it has proved a most successful remedy. In the use of antispasmodics we must avoid judging the effects of one from the failure of another of the same class; but in difficult cases we must try each in succession—for it often happens that the successful remedy is only arrived at after repeated trials.

The mineral waters of Mont Dore and La Bourboule contain arsenic, and appear to act favourably in the more purely neurotic cases of asthma, while those of the Pyrenean sulphur springs of Eaux Bonnes, Eaux Chaudes, and Cauterets, are reputed to exercise a beneficial influence over the malady, but they have not been successful in the writer's experience, and it is more probable that they relieve by reducing the catarrhal symptoms than that they either allay the spasm or prevent its recurrence.

Compressed air baths at pressures varying from half to two-thirds of an atmosphere, and lasting two hours, are of the greatest benefit to asthmatics, and appear to reduce the sensitiveness of the pulmonary plexus and to diminish cough and spasm, but they must be taken in numbers varying from 24 to 50 to be of permanent value. *See* AIR, Therapeutics of.

The *dietetic* treatment varies in individual cases, but as a rule asthmatics should dine early, and for the rest of the day limit themselves to liquid food, such as beef-tea, soups, and milk, combined with such an amount of stimulant, in the form of a pure spirit, as may be necessary, thus avoiding any distension of the stomach and intestines before retiring to rest. The diet should consist of brown bread, dry toast, and biscuits—excess of starch in any form being studiously avoided, a fair supply of plainly cooked meat, fish or poultry, and a limited amount of vegetables and fruit, care being taken to select only the most digestible of each class. Stimulants may sometimes be taken, but with discernment.

C. THEODORE WILLIAMS.

ASTIGMATISM (ἀ, priv.; and στίγμα, a spot or point).—SYNON.: Astigmism.—Want of symmetry in the anterior refracting surfaces of the eyeball, in consequence of which rays of light proceeding from a point are not brought to a focus upon the retina as a point, but only as a diffused spot. *See* VISION, Disorders of.

ASTRINGENTS.—DEFINITION.—Medicines which cause contraction of tissues.

ENUMERATION.—The chief astringents are: Nitrate of Silver; Sulphate of Copper; Sulphate of Zinc; Acetate of Lead; Perchloride of Iron; Alum; Tannic and Gallie Acids, and vegetable substances containing them, such as Oak Bark, Galls, Kino, and Catechu; and Dilute Mineral Acids. Some authors also include in this class of remedial agents such articles as Ergot of Rye, which contracts the blood-vessels and lessens hæmorrhage after it has been absorbed into the blood, although it has no local astringent action.

ACTION.—With the exception of gallie acid, the substances already mentioned coagulate or precipitate albumin. Dilute mineral acids do not coagulate albumin, but precipitate many albuminous bodies from the alkaline fluids by which they are held in solution. When applied to a surface from which the epidermis has been removed, the other astringents combine with the albuminous juices which moisten this surface, as well as with the tissues themselves, and form a pellicle more or less thick and dense, which in some measure protects the structures beneath it from external irritation, at the same time that they cause the structures themselves to become smaller and more dense. On a mucous membrane they have a similar action, and they lessen its secretion. It was formerly supposed that their action was partly due to their causing the blood-vessels going to a part of the body to contract, thus lessening the supply of fluid to it; as well as to their effect on the tissues themselves. But experiment has shown that, while nitrate of silver and acetate of lead possess this power, perchloride of iron and alum do not, and that tannic and gallie acids actually dilate the vessels. The astringent action of these latter drugs must therefore be exerted upon the tissues.

USES.—Astringents may be employed *locally* in various forms. In the solid form, as a powder, or in various preparations such as lotions, ointments, plasters, glycerines, &c., they are applied, especially the metallic astringents, to wounds and ulcers for the purpose of reducing the size and increasing the firmness of exuberant granulations, as well as of protecting the surface by forming a pellicle over it. They are used to lessen congestion and diminish the secretion of the various mucous membranes: as a lotion to the eye and mouth; as a gargle or a spray to the throat; in the form of an injection to the nose, urethra, and vagina; and as a suppository to the rectum. Administered internally, several astringents have a powerful effect in checking diarrhœa, and certain of them may have a local action upon the stomach and intestines.

The *remote* action of such astringents as acetate of lead and gallic acid, when absorbed into the blood, in lessening hæmorrhage, is made available in the treatment of hæmoptysis, hæmatemesis, hæmaturia, and loss of blood from other parts of the body.

T. LAUDER BRUNTON.

ASTURIAN ROSE.—The rose or erythema of the Asturias; one of the numerous synonyms of pellagra—*Mal de la rosa; Lepra asturiensis; Elephantiasis asturiensis. See* PELLAGRA.

ASYSTOLE (ἀ, neg.; and συστολή, a contraction).—SYNON.: Fr. *Asystolie*; Ger. *Mangelende Zusammenziehung.*—The most advanced stage of progressive failure of the heart, in which the ventricular walls have become so feeble that the systole is incomplete and highly irregular, and the cavities are dilated from over-distension with undischarged blood. *See* HEART, Dilatation of.

ATAVISM (*atavus*, a grandfather).—The inheritance of a disease or constitutional peculiarity from a generation antecedent to that immediately preceding. *See* DISEASE, Causes of.

ATAXIA
ATAXIC } (ἀ, priv.; and τάξις, order).—Terms which originally meant any irregularity or disorder, but are now specially applied to irregularity of associated or co-ordinated muscular movements. The noun is frequently used as synonymous with the disease known as locomotor ataxy. *See*

Co-ordination, Disorders of; and Locomotor Ataxy.

ATELECTASIS (ἀτελὴς, imperfect; and ἔκτασις, expansion).—Absence or imperfection of the expansion of the pulmonary alveoli which normally takes place at birth, the lungs thus remaining more or less in their fœtal condition. *See* Lungs, Collapse of.

ATHEROMA.—*See* Arteries, Diseases of; and Aorta, Diseases of.

ATHETOSIS (ἄθετος, without fixed position).—Definition.—A name given by Dr. Hammond, of New York, to a condition in which the hand and foot are in continual slow, irregular movement, and cannot be retained in any position in which they may be placed.

Description.—The special character of the movements in athetosis is that they are slow and deliberate. They usually affect the arm and leg on one side only. Voluntary power is retained, but is interfered with by the slow spasm. The fingers are irregularly flexed and extended: at one moment they spread wide apart, the thumb being overstretched; thereafter, first one, then another, is bent into the palm, and again extended. The movement can be arrested for a moment in certain positions by the will, but is renewed with increased force. The foot is usually inverted; the toes being flexed or extended, but in less constant movement. The spasm may cause pain. The muscles sometimes become hypertrophied. The movements in some cases cease during sleep, in others they do not. Sensation is often, but not always impaired.

The onset of this condition has been sudden in a few cases, but usually the movements develop gradually after a unilateral seizure, whether a slight, sudden hemiplegia, or a convulsion. The subjects have been generally in middle life.

Athetosis differs from the spastic contracture so common after hemiplegia in children, only in the slowness of the movements, and in the fact that they are spontaneous and not limited to voluntary movement. But these distinctions are not absolute. The disorder of movement after hemiplegia may be identical in character with athetosis, and both are essentially the same in relations. In what is termed athetosis the cerebral lesion is so placed as to cause no distinct hemiplegia in most cases; but its occurrence is indicated by the sudden symptoms which precede the slow movement. It cannot be regarded as a distinct disease or even a distinct symptom. Typical athetosis may succeed hemiplegia.

Pathology.—It is probable that, as Dr. Hammond suggests, the seat of the lesion in athetosis is generally the optic thalamus or its neighbourhood. The sudden onset of the disease and the slight affection of sensation are in favour of this explanation of cases in which there is no distinct hemiplegia. Charcot believes that all post-hemiplegic chorea-like movements depend on the implication of fibres outside the optic thalamus. In a case of simple ataxy after hemiplegia—an analogous condition—the writer has found a cicatricial sclerosis extending across the optic thalamus, and probably left by a patch of softening. The symptoms, perhaps, may be produced in various ways, since the regulation of the motor processes in the cortex is complex. One cause of them may be a state of perverted action of the motor cells of the cortex, due to a deficiency of the upward influence from the cerebellum. Another may even be partial damage to the motor centres themselves.

Prognosis.—This is unfavourable; but the slighter cases improve and may even approximately recover.

Treatment.—Nervine tonics and sedatives are the remedies chiefly indicated. Of the former arsenic, and of the latter Indian hemp and bromides, may be given. The continuous current has been known to lessen the spasm, but, as a rule, it fails. The positive pole may be placed on the spine or brachial plexus, the negative on the muscles involved. The action of the continuous current is probably in part direct, in part reflex, lessening by the peripheral impression the over-action of the centre.

W. R. Gowers.

ATONY
ATONIC (ἀ, priv.; and τόνος, tone).—Terms implying want of tone, power, or vigour, associated either with such a condition of the system generally, or of particular organs, especially those which are contractile. *See* Tone, Want of.

ATRESIA (ἀ, priv.; and τίτρημι, I pierce). Absence of a natural opening or passage, whether congenital or caused by disease.

ATROPHY, GENERAL. — Synon.: Marasmus.

Definition.—Atrophy means, etymologically, simply want of nourishment (ἀ, priv.; and τροφή, nourishment), but the term is commonly applied to the condition resulting from want of nourishment, namely, wasting or diminution in bulk and substance, even though this may have been produced by some other cause, and even though the supply of nutritive material may have been abundant. *General atrophy* is used to denote wasting in which the whole body participates. All acute diseases, if severe, are accompanied by emaciation, for at such times nutrition is temporarily interfered with. The use of the word 'atrophy' is, however, confined, as a rule, to cases where the interference with nutrition has been gradual, and the loss of flesh consequently slow.

Ætiology.—Atrophy is common enough at all periods of life. In infants and children it is due, in the majority of cases, to chronic functional derangements which interfere with the digestion and elaboration of food. Less frequently it is a consequence of organic disease. In adults general atrophy seldom results from any other cause than organic disease, and functional disorder as a cause of serious wasting is the exception. In old age atrophy is a common consequence of the degenerations of tissue which accompany the decline of life. The interference with nutrition may, however, be aggravated by the presence of disease.

In *infants under twelve months old* there are four principal causes to which persistent wasting can usually be referred, namely, unsuitable food; chronic vomiting (gastric catarrh); chronic diarrhœa (intestinal catarrh); and constitutional diseases, such as inherited syphilis or tuberculosis. Bad feeding, by setting up a chronic catarrhal condition of the stomach and bowels, is a frequent cause of both vomiting and diarrhœa, but it may produce atrophy without either of these symptoms. When an infant is fed, for instance, with large quantities of farinaceous matter—a form of food which is alike indigestible and innutritious—a very small part only can enter as nutriment into the system. The remainder passes down the alimentary canal, and is ejected at rare intervals in an offensive putty-like mass or in hard roundish lumps. The child, therefore, although overloaded with food, is really under-nourished, and loses flesh as long as such a diet is persisted in. If, as often happens, diarrhœa or vomiting be set up by the irritation to which the digestive organs are subjected, wasting is more rapid and the danger of the case is increased. Not only excess of farinaceous matter, but any form of bad feeding will produce this result. Wasting, indeed, will be found in every case where the food selected is unfitted for the child, and thus it is not infrequently seen in infants who are fed upon milk and water alone. The casein of cow's milk is difficult of digestion by many infants on account of its tendency to coagulate into a large firm clot like a lump of cheese. In this respect it differs from the curd of human milk, which forms light small flocculent coagula, and is digested without difficulty. Special preparation is therefore generally required to render cow's milk a suitable diet for a young child.

It is not only, however, unsuitable food which is a cause of atrophy in infants. Catarrh of the stomach and bowels may be present, although the feeding is in all respects satisfactory. Infants are excessively sensitive to chills, and catarrh of their delicate digestive organs is easily excited. Now, catarrh of a mucous membrane is always accompanied by an increased flow of mucus, and this alkaline secretion in excess acts as a ferment, and sets up decomposition of food. A subacute gastric catarrh from this cause is not rarely seen in new-born infants, who thus are rendered for the time incapable of digesting even their mother's milk. In such cases the fault is usually attributed to the milk, which is said to be unsuited to the child; and the mother is compelled, much against her will, to wean her baby and feed it in a different way. So long as the catarrh continues, however, no food appears to agree, and the child often after a time dies exhausted.

Between the ages of *one and three years* atrophy is commonly associated with rickets. In these cases the wasting is noted chiefly about the chest and limbs, for the belly is large and swollen from flatulent accumulation. At this age children are still liable to waste from catarrh of the stomach and bowels; indeed, rickets is itself often complicated by such derangements. Sarcoma of the internal organs is also sometimes found at this time of life, and is attended with extreme emaciation.

After the age of three years caseous enlargements of the mesenteric glands, if extensive, may become a cause of wasting.

After the fifth or sixth year chronic pulmonary phthisis begins to appear. Cases of heart-disease as a result of acute rheumatism are also more frequently seen. Diabetes, too, is sometimes met with. All these diseases may produce much interference with nutrition.

From the time that the child begins to take other food than that furnished by his mother's breast, he is liable to worms in the alimentary canal. The presence of worms is frequently accompanied by loss of flesh, not, perhaps, so much on account of the parasites themselves, as on account of the derangement of the digestive organs which is associated with them. Emaciation due to this cause may sometimes be extreme.

In the adult atrophy is rarely the result of mere functional derangement, but is almost invariably a sign of serious organic disease. All chronic ailments are not, however, accompanied by marked wasting. Purely local diseases lead to little loss of flesh unless they affect some part of the digestive apparatus, or of the glandular system which is concerned in the elaboration of nutritive material; or otherwise directly influence the processes of nutrition. Thus, emaciation quickly results from gastric ulcer or chronic dysentery, but chronic pneumonic phthisis may produce little diminution in weight if there is no pyrexia, and if the case is not complicated by diarrhœa or profuse expectoration. The most marked atrophy is produced by the constitutional diseases, such as cancer, tubercle. and syphilis in the third stage; by those which set up a persistent drain upon the system, such as severe albuminuria, chronic hæmorrhages, and long-continued suppurations; or by those which directly impede the passage of nutritive material into the blood; and in the latter class of diseases, influences which act directly upon the thoracic duct, such as obstruction to its passage from pressure by aneurysm and other tumours, must not be overlooked. There is a form of atrophy sometimes seen in hysterical females, depending upon disordered innervation, in which the most extreme emaciation may be reached. Such cases are marked by a dislike to food which may amount to absolute loathing. *See* NEURASTHENIA.

ANATOMICAL CHARACTERS. — The most marked post-mortem appearance in this condition is diminution or loss of fat, especially of the subcutaneous adipose tissue; and this is accompanied by wasting of the tissues and organs generally. The histological elements are reduced in size without undergoing, as a rule, actual numerical diminution. With the atrophy is often associated a certain amount of fatty degeneration.

SYMPTOMS.—The symptoms of general atrophy are loss of flesh, loss of colour, and loss of strength, combined with other special phenomena arising from the particular disorder to which the impairment of nutrition is due.

TREATMENT.—The treatment of general atrophy consists in removing, if possible, the impediment to efficient nutrition. In the case of a child the diet must be selected with care. Excess of farinaceous food is to be avoided, and cow's milk can be diluted, if necessary, by admixture with barley water. Warm woollen clothing should be insisted upon, and special attention should be paid to the warmth of the feet. Any gastric or intestinal derangement must be at once remedied, plenty of fresh air should be obtained, and perfect cleanliness strictly enjoined. In an adult the disease which is the cause of the malnutrition must be sought for and submitted to treatment. Efforts should be made, on the one hand, to arrest any drain upon the system; and, on the other hand, by a judicious arrangement of the dietary, and by attention to the eliminatory organs, to remove all obstacles to nourishment. Even in cases of organic and incurable disease much benefit may often be derived from due observance of physiological laws. EUSTACE SMITH.

ATROPHY, LOCAL.

ATROPHY, LOCAL.—This condition signifies atrophy of a *part* of the body, which may be apparently congenital, or may be produced by various causes acting during life. It will be convenient to consider local atrophy according to the several forms which are met with.

Congenital Atrophy.—Congenital atrophy is that condition in which some part of the body never reaches its full standard of size. It is more correctly denominated *arrested growth* or *congenital smallness.* When the whole of one side of the body is thus affected, a marked and permanent disproportion between the two sides results. This *hemiatrophy* is, in theory, difficult to distinguish from hypertrophy of the opposite side, but mostly the paralytic or enfeebled state of the atrophic side shows it to be abnormal. The limbs are most strikingly implicated; while the corresponding side of the face and head is sometimes similarly, sometimes conversely, affected. In some cases atrophy of the opposite half of the cerebrum was found on post-mortem examination. The same condition may be partial—*hemiatrophia partialis,* and it then chiefly affects the face, or some part of the territory of the fifth cranial nerve. These conditions must be ascribed to some perversion of innervation occurring during development. Other congenital atrophies, *local* but not *hemi*-atrophic, are more probably referred to obstruction of blood-vessels during the same process. The defective development of the brain in cretinism has been attributed to the pressure of an enlarged thyroid upon the carotid arteries.

Physiological Atrophies.—These form a distinct class, where atrophy of a part of the body takes place in the ordinary course of development. Such are the wasting of the thymus gland in early life, of the mammæ and sexual organs after a certain age. Most commonly the atrophy is here closely connected either with the involution or perhaps the development of some correlated organ; but it is not possible to say what the nature of this connexion is, whether one of nutrition or innervation.

Acquired Atrophies.—The conditions thus distinguished possess most interest for the practical physician. Wasting of any part of the body during life, when not physiological, usually depends either upon some interference with the blood-supply, or some disturbance of innervation; but to these must be added, in the case of organs which have an active and continuous function, disuse or over-stimulation. Deficient blood-supply, which causes atrophy, may be produced by the obstruction of a nutrient artery, especially if it be gradual, since sudden blocking will produce more complicated phenomena. Constant pressure is a cause of atrophy, because it interferes both with the blood-supply, and with the vital actions of the tissue-elements. Intermittent pressure, on the other hand, by causing hyperæmia, is more likely to lead to hypertrophy. Moreover, inadequate renewal of blood—that is, filling of the vessels, even to excess, with venous blood—or venous engorgement, though at first it may cause enlargement, mostly leads to atrophy in the end; as is seen in the granular induration of liver and kidneys caused by disease of the heart obstructing the circulation. Many forms of atrophy in old age are clearly dependent upon senile obstruction of the arteries, for example, that of the skin, spleen, and kidneys. The instances of atrophy from disturbed innervation are less easy to discriminate, except where there is actual paralysis. In two distinct diseases, however,—progressive muscular atrophy and infantile or essential paralysis, loss of power in the muscles is followed by a remarkable wasting, far more rapid than that which results from disuse alone. Division of the nerve of a limb produces rapid wasting of the muscles no longer used, and this is accompanied in the end by some diminution in the size of the bones and accessory parts. Local atrophy of the skin is sometimes seen in regions limited by the distribution of a nerve, especially some branch of the fifth; and more extensive atrophy of one side of the face or head, equally marked out by nervous distribution, and resembling some cases of congenital atrophy, has also, though rarely, been observed. In such cases the writer has found anæsthesia of parts corresponding to branches of the fifth nerve, but absence of muscular paralysis, such as would be due to affection of the seventh nerve.

Disuse produces atrophy only in organs whose functions are active and constant, such as nerves and muscle. Nervous tissue wastes constantly, and sometimes rapidly, when currents cease to traverse it. This is seen not only in the nerves of paralysed limbs, but even in the nerve-centres, where any interruption of the nervous channels, either above in the cerebrum, or below in the nerve-trunks, is followed by degeneration, ending in atrophy, of the whole nervous tract leading from the cerebral cortex to the peripheral termination—so-called *secondary degeneration* of tho cord. In muscular tissue the wasting is almost as constant, but hysterical paralyses make an exception, the helpless limbs preserving their nutrition in a surprising manner. In organs whose functions are intermittent or periodic, disuse does not appear necessarily to produce atrophy, as is seen in the testicles, ovaries, and mammæ.

That excessive stimulation or over-work may produce atrophy is seen in degenerative diseases of the nerve-centres arising from undue mental activity; and of the sexual organs from excessive indulgence. Overwork of muscles very rarely produces atrophy; but the writer has seen instances where special muscles were exposed to strain while the general nutrition was low. Atrophy of muscles is said to occur in soldiers when badly fed, after long exhausting marches.

Unexplained Atrophies. — Cases of local atrophy occur of which it is impossible to give any satisfactory explanation. Such are the conditions known as linear atrophy of the skin; some remarkable cases of atrophy of bone, especially of the skull (*fragilitas ossium*), and of some parts of the cerebrum. Atrophy of the thyroid gland appears to be certainly the cause of the disease called myxœdema, but the cause of the original atrophy is unknown.

It is possible that deficiency of special kinds of food may lead to atrophy of special organs—thus deficiency of lime may make the bones soft, and deficiency of iron arrest the development of blood-corpuscles; but even these familiar instances must be accepted with a little reserve. In the same way it is still doubtful whether any special drugs, such as iodine, can produce atrophy of special glands.

Pathology.—Wasting may occur simply, or as a consequence of change of substance, or from the intrusion of some new material; in other words, there may be *simple* atrophy, atrophy from *degeneration*, or atrophy by *substitution*. The first is probably rare; generally some change of substance occurs. The most frequent degenerative process is fatty degeneration; the albuminous substance being replaced by fatty matter, which, if afterwards absorbed, leaves a void. Organs thus affected may be apparently enlarged, though the original substance is wasted. Atrophy from substitution is seen when the connective tissue of an organ, for instance, increases, compressing and destroying the other tissue-elements; and these not being renewed when the newly-formed connective tissue contracts, the whole organ is diminished in bulk. This is seen in all the changes called cirrhosis or fibroid degeneration, as in cirrhosis of the liver and kidneys.

Treatment.—No general rules can be laid down for treating all cases of local atrophy. Where the blood-supply is deficient, we have rarely any means of supplementing it; where innervation is at fault, it is seldom under our control. In general, harm rather than good results from any attempt to attract blood by artificial irritation. In the case, however, of atrophy from disuse of the nervo-muscular system, a line of treatment, and more especially of prophylaxis, is very clearly indicated; this is, to keep the muscles in exercise by artificial means, particularly by electricity, or by the processes of friction and kneading known as passive motion (*see* Massage). In this way so much of the atrophy as is due simply to disuse may be checked for the future, and even the former loss reinstated. We shall, moreover, never do harm by attempting to supply some special elements of food which appear to be deficient, as iron for the blood and phosphorus for the bones or nervous system. J. F. Payne.

AUDITORY NERVE, Diseases of. *See* Ear, Diseases of; and Hearing, Disorders of.

AURA (αὖρα, a breeze).—A peculiar sensation, subjective in origin, immediately preceding an epileptic or hysterical convulsion, and named respectively *aura epileptica* and *aura hysterica*. The word was originally adopted because the sensation is often described as that of the passage of cold air or light vapour from the trunk or extremities to the head; but it has been extended so as to include any phenomenon, whether sensory or motor, that ushers in a fit of epilepsy or of hysteria.

AURAL DISEASES.—*See* Ear, Diseases of.

AUSCULTATION (*ausculto*, I listen). A method of physical examination, which consists in listening over various parts of the body, either by the direct application of the ear (*immediate auscultation*), or by the aid of special instruments (*mediate auscultation*), for the purpose of studying certain sounds produced in health and disease. *See* Physical Examination.

AUSCULTATORY PERCUSSION. A method of physical examination, in which the sounds elicited by percussion are studied by means of auscultation. *See* Physical Examination.

AUSTRALASIA.—The portion of Polynesia lying between 10° and 50° S. latitude, and 110° E. and 170° W. longitude, which may be said to include Australia, Tasmania, New Zealand, the Fiji Islands, the New Hebrides, and some less important islands.

Australia.—The climate of the vast continent of Australia, which is partly temperate and partly tropical, depends, first, on its latitude, and, secondly, on its conformation, the mountain ranges being distributed along the coast lines, especially on the eastern shores. In the interior, which is comparatively flat, and believed to be for the most part a sandy desert, there is great heat and little rain. The hot winds from the interior are often sufficient, in the summer, to raise the thermometer to 127° Fah., and on the amount of protection from these enjoyed by the various towns depends their climate. There are also sea winds from the N. and N.E. The southerly winds, prevailing chiefly from November to February, blow from the Antartic Circle, and are cold winds of great velocity, ending in heavy thunderstorms. In the tropical region the rainfall is from November to April; and in the temperate, which lies to the east and south, it prevails only in the winter season.

The following are among the principal towns or centres to which invalids proceed:—

Adelaide, the capital of South Australia, lat. 35° S., long. 135½° E. It suffers from great heat and drought. The mean temperature is 65°, the maximum 115°, and the minimum, 34°; the range being 81°, and the mean daily range 20°. The humidity is 60 per cent., and the rainfall 21 inches. The soil is sandy.

Brisbane, the chief town of Queensland, lat. 27½° S., long. 153° E. The climate is almost tropical. The mean temperature is 70°, the maximum is 108°, the minimum, 34°; the range 74°, with a mean daily range of 21°. The rainfall is 51 inches, and the mean humidity 76 per cent. Queensland is for the most part elevated; and the climate of the Darling Downs, on an average 2,000 feet above sea-level, is considered very fine. The townships at Toowoomba and Warwick in this region may be recommended.

Melbourne, the capital of Victoria, lat. 38° S., long 145° E. It has the reputation of being a healthy and agreeable residence; the climate being dry and temperate, and far cooler in summer than that of Sydney. Mean temperature 57°, maximum 111°, minimum 27°, showing a range of 84°; daily range 18°. Mean humidity 72 per cent. Rainfall, 26 inches.

Perth, in Western Australia, very healthy, but as yet little suited to the requirements of invalids. The temperature is 63° (mean), and the rainfall 30 inches in 110 days.

Sydney, the capital of New South Wales, lat. 34° S. and long. 151° E. The climate of New South Wales is clear and dry, the temperature depending more on the altitude than on the latitude. The plains in the interior, swept by hot winds, are very dry, while the coast districts have abundant rain. Mean temperature 62·5°, maximum 107°, minimum 36°; range 71°; mean daily range 14°. Humidity 72 per cent., and rainfall 50 inches. Paramatta, on Port Jackson, is drier and cooler than Sydney (Lindsay); and the Illawara district, including the stations of Eden and Twofold Bay, is suitable for invalids; but the finest climate in Australia for pulmonary cases is to be found in the Riverina, a district lying between Queensland, the Blue Mountains, and the central desert, consisting of rolling prairie and undulating downs, with a rainfall ranging from 5 to 24 inches, the average being 14 inches, and a clear bright atmosphere, most exhilarating in its effect on invalids, who at the settlements of Deniliquin, Menindee, and the various sheep-farms, pursue an open-air life by day, and often by night, with great advantage.

Tasmania.—Tasmania lies 150 miles south of Australia, between lat. 40° 40′ and 43° 38′, and is mountainous, with a deeply indented coast-line. The climate is more temperate and equable than that of the south coast of Australia. In winter the cold is sufficient to produce thin ice in the low lands, and snow showers in the higher ranges. The mean temperature of *Hobart Town* on the S.E. coast is 54°, the summer mean being 62° and the winter 47°. The rainfall varies greatly, from 100 inches at Macquarie Harbour on the W. coast to 24 inches at Hobart Town, distributed over 145 days. The prevalent winds are from the N.E. and S.W. The climate is favourable to infant life, and the country is regarded as a sanatorium for invalids.

New Zealand.—New Zealand lies between 34° 50′ and 47° 50′ S. lat., and consists of a North and a South besides smaller Islands. The North Island is for the most part volcanic, and abounds in hot springs, which are extensively used, and active craters, which impart an important influence to its climate. The South Island contains a lofty range of snowclad mountains, whose lower slopes form on the eastern shore a series of terraces known as the Canterbury Plains, and other fertile regions.

The climate is mild and bracing, but decidedly of a windy character, and not suited for all invalids: at Auckland in 1876 no calm day was recorded, the prevalent winds being W.S.W. The mean temperature of the North Island is 58°, of the South 54°. The maximum varies from 87°, at Christ Church, to 75°, at Hokitika, and the minimum from 25° to 34° in the South Island. Cold is as a rule unknown in the North Island, while in the South there are a few snowy days each year on the coast. The rainfall varies from 32 inches in 135 days at Christ Church, to 131 inches in 186 days at Hokitika.

Fiji Islands.—The Fiji Islands, partly of volcanic and partly of coraline origin, have a tropical climate, moderated by the trade winds, so that the mean temperature does not exceed 80°, the minimum being given as 65°. The rainfall is chiefly from October to April—the hot season, and varies from 124 to 215 inches in 170 days. *See* CLIMATE Treatment of Disease by.

C. THEODORE WILLIAMS.

AUTOPHONIA (*αὐτός*, himself; and *φωνή*, the voice).—A physical sign obtained by studying the modifications of the resonance of the observer's own voice during auscultation. *See* PHYSICAL EXAMINATION.

AUTOPSY. *See* NECROPSY.

AX, in Ariége in France.—Thermal waters. *See* MINERAL WATERS.

AZORES; St. Michael.—Warm, very moist, equable climate. Mean winter temperature 58° F. Prevailing winds N. and E. *See* CLIMATE, Treatment of Disease by.

AZOTURIA.—A condition of the urine in which there exists an absolute and relative excess of urea, without accompanying pyrexia. *See* URINE, Morbid Conditions of.

B

BACILLI (*bacillum*, a little rod or staff). SYNON.: Fr. *Bacilles*; Ger. *Bacillen*.

The term *bacillus* was applied by Cohn to the longer rod-shaped bacteria, *bacterium* to the shorter forms; filaments being distinguished as 'leptothrix,' 'vibrio,' &c. But the great variety in length of the individual elements of the same organism, and the variations under different conditions and periods of life, rendered such a distinction impossible. Hence the term *bacillus* is now used for all the species of schizomycetes which commonly have the form of straight rods, although in some conditions of growth they may form filaments. By some mycologists the term is used in a more restricted sense; but it seems well at present to use it in this somewhat wide manner, until our knowledge allows of more scientific classification. *See* MICRO-ORGANISMS.

BACTERIA (*βακτήριον*, a rod).—SYNON.: Fr. *Bacteries*; Ger. *Bacterien*.

Originally applied to common rod-shaped organisms of the class *Schizomycetæ*, and especially to one supposed variety called *Bacterium termo*, this name was later extended to include the whole of the class of schizomycetes or fission-fungi. Thus the term *bacteriology* has been practically applied to the whole science of the lower orders of chlorophylless algæ. But of late, owing partly to the confusion involved in the double use of the term for the rod-shaped organisms and for the entire class; partly to the fact that fungi of other orders than schizomycetes are related to parasitic disease; and perhaps still more to the dominant influence of Pasteur and the French school, the term *microbes* has largely replaced the names 'bacteria' and 'micro-organisms'; and for the particular species formerly named *bacterium x, y,* &c., the more accurate terms *bacillus*, *spirillum*, &c., are used. *See* MICRO-ORGANISMS.

BADEN-BADEN, in Germany.—Thermal saline waters. *See* MINERAL WATERS.

BADEN, in Austria.—Thermal sulphur waters. *See* MINERAL WATERS.

BADEN, in Switzerland.—Thermal sulphur waters. *See* MINERAL WATERS.

BADENWEILER, in Germany. Simple thermal waters. *See* MINERAL WATERS.

BAGNÈRES - DE - BIGORRE, in France. — Simple thermal and earthy waters. *See* Mineral Waters.

BAGNÈRES - DE - LUCHON, in France.—Thermal sulphur waters. *See* Mineral Waters.

BALANITIS — BALANOPOSTHITIS (*βάλανος*, an acorn; and *πόσθη*, the foreskin).—Synon.: Bastard Clap; *Blennorrhagia Balani*; Inflammatory Phimosis.

Definition.—Inflammation of the opposing surfaces of the glans and prepuce; sometimes acute—even gangrenous, and sometimes chronic. A purely local affection; frequently, but not necessarily, of venereal origin.

Ætiology.—Balanitis is much less common than urethritis, being met with at the Lock Hospital in the proportion of one to twenty-four of the latter. It may be either primary; or consecutive to chancres, syphilitic eruptions, warts, accumulated smegma, variolous pustules, or gonorrhœa. When primary, the common predisposing cause is a long, tight foreskin. Fournier attributes two-thirds of the cases of balanitis to a long prepuce with insufficient cleansing; about one-third to irritation by chancres and gonorrhœal pus; and a very few to other causes.

Symptoms.—The symptoms of balanitis depend on the intensity and extent of the inflammation. In the simplest form there is heat and itching of the furrow, slight redness of that part, with a milky or yellowish secretion. When the inflammation is more severe and extended, swelling and pain are added, the other symptoms are more marked, and characteristic excoriations appear. These excoriations are irregular, shallow, never extending deeply, but often coalescing into large raw chafings. An abundant yellowish-green matter of offensive odour bathes the surface. When the urine trickles over these excoriations there is severe smarting pain. If still further irritated, the foreskin swells enormously, is divided at the free border by deep creases, and can no longer be turned back. Aching, smarting, great tenderness, and painful erection, often accompanied by constitutional disturbance and fever, are present.

Complications.—The cellular tissue and the lymphatic ducts of the foreskin and sheath, or the lymphatic glands, may inflame to suppuration, to ulceration, and, in persons enfeebled by any cause, even to gangrene. Sloughing begins on the inner surface of the foreskin at the upper part; seldom to much extent, though the whole prepuce, except the frænum, may be lost, and when cicatrisation sets in the organ appears circumcised. Paraphimosis is caused by imprudent retraction of a swollen foreskin. Warts keep up chronic posthitis of the furrow. Adhesions, usually at the corona and the furrow, may attach the prepuce completely to the glans. Thickening and phimosis are not uncommon after repeated attacks.

Course.—The duration of balanitis depends on the anatomical condition of the parts. When remedies can be easily applied, it is not more than three or four days. With phimosis, the course is severe, and the duration is indefinite; even when limited to the furrow, posthitis is often obstinate.

Diagnosis.—This is easy when the parts can be exposed. *Herpes* is distinguished from balanitis by small round ulcers, grouped on a red area, and limited to one or two points of the mucous surface, without general congestion. *Simple chancre* has well-defined undermined edges and a spongy surface. The *syphilitic sore* has the indurated base and enlarged lymphatic glands. When there is phimosis, the discharge may come from the urethra or from a chancre. If from the urethra, it can usually be seen escaping thence, and there is pain along the penis, with other signs of urethritis. An ulcer under the foreskin is betrayed by a hard and tender swelling felt through the skin, and after the lapse of a few days consecutive sores usually appear at the orifice of the prepuce.

Prognosis.—The prognosis of balanitis in the simple form is always good. If the complaint is secondary or symptomatic, gangrene is not uncommon.

Treatment.—The chief indication is to keep the inflamed surfaces separate. After washing and thoroughly drying, the excoriations should be touched with a 10-grain solution of nitrate of silver, and a bit of dry lint laid on the glans before the foreskin is drawn forward. If there is phimosis, frequent injections of tepid water, and twice daily of a 5-grain solution of nitrate of silver, must be thrown to the farthest part of the foreskin with a long-nozzled syringe. Leeches to the groins, and morphine internally, or hypodermically, relieves pain. Acupunctures give vent to simple œdema, but tend to accelerate gangrene with brawny tension and erysipelatous redness. Incisions, if needed, should be free; one on each side, carried quite back to the furrow. The upper half of the foreskin can then be easily turned back, and the subsequent deformity is less than if the foreskin were divided at the dorsum. In paraphimosis, before replacing the swollen foreskin, the tension should be relieved by acupuncture and astringent lotions, or by incisions if needed. Chancres and inflamed inguinal glands must be treated with the balanoposthitis according to their needs. When there is an ulcer, concealed by phimosis, and the syringing with warm water has cleared away the discharge, an injection of 20 drops of the following emulsion (iodoform, 1 part; powdered tragacanth, 1 part; glycerine, 3 parts; water, 10 parts) rapidly subdues irritation and ulceration. If the signs of syphilitic infection be present; *i.e.*, the persistence of defined induration when the general inflammatory swelling is subsiding, quill-like thickening of the dorsal lymphatic ducts of the penis, and multiple enlargement of the lymphatic glands in the groin, mercury should be administered without delay, in quantity sufficient to bring on and maintain slight sponginess of the gums.

Berkeley Hill.

BALDNESS.—Synon.: Alopecia; Fr. *Calvitie*; Ger. *Kahlheit.*

Description.—Baldness or loss of hair presents an extensive range of variation in degree, from moderate thinness of the hair, such as occurs in *defluvium capillorum*, to complete baldness—*alopecia calva* or *calvities*, the latter not limited to the scalp alone, but involving eyebrows, eyelashes, beard, and every hair of the body. Instead, however, of being *general*, baldness may be *partial*, affecting more or less of the surface of the scalp for example, the summit and forehead in men, and the summit and occiput in women. One remarkable form of partial baldness has been denominated *alopecia areata*, or simply *area*, and as this was described by Celsus, it has likewise been called *area Celsi.* Area occurs suddenly, and is a mere falling-off of the hair over a space of circular figure; there may be one or more of such areæ, and sometimes area is only the beginning of calvities. Area is likewise occasionally met with in the whiskers and beard. *See* Alopecia Areata.

Ætiology.—The causes of alopecia are exhausted nutritive power of the skin; nerve-paresis in the case of area; syphilis; and local injury. The alopecia of syphilis follows the plan of distribution of its exanthem. Partial alopecia may result from a blow; from the accidental tearing out of a lock of hair; from the sting of a bee; from nervous shock; or from other causes.

Pathology.—The pathology of alopecia is a loss of nutritive power of the skin, sometimes progressive, and consequent on advancing age, as in general baldness; and sometimes limited to a nerve-district of small extent, as in area. This fact is very evident in the latter form, inasmuch as, conjoined with the sudden dropping-out of the hair, the integument is pale and thin, poorly nourished, somewhat anæsthetic, and thinner in the centre than at the circumference; while the hairs which remain at the periphery are altered in structure, clubbed and broken off.

Treatment.—This consists in the restoration of nerve-power and nutritive power, and in local stimulation. The best applications for the latter purpose are the stimulating liniments of the British Pharmacopœia; *e.g.* liniment of ammonia, compound camphor liniment, and the liniments of chloroform and mustard; or the acetum cantharidis properly diluted for general alopecia, or applied with a brush in its concentrated form for area. In the treatment of the latter, ammonia, turpentine, and the compound tincture of iodine are likewise useful; while for syphilitic alopecia the white precipitate ointment with camphor is the best local application, conjoined with anti-syphilitic constitutional treatment. *See* Hair, Diseases of.

Erasmus Wilson.

BALNEOLOGY (βαλανεῖον, a bath; and λόγος, a word).—A scientific exposition of all that relates to baths and bathing. *See* Baths; and Hydrotherapeutics.

BALNEOTHERAPEUTICS (βαλανεῖον, a bath; and θεραπεύω, I heal).—That department of therapeutics which deals with the application of baths in the treatment of disease. *See* Baths; and Hydrotherapeutics.

BARBADOES LEG.—A form of Elephantiasis. *See* Elephantiasis.

BARBIERS.—A synonym for Beriberi. *See* Beriberi.

BARÈGES, in France.—Thermal sulphur waters. *See* Mineral Waters.

BARTFELD, in Hungary.—Alkaline saline chalybeate springs, with iodine. *See* Mineral Waters.

BASEDOW'S DISEASE.—A synonym for exophthalmic goître. *See* Exophthalmic Goître.

BATH, in Somersetshire.—Simple thermal and earthy waters. *See* Mineral Waters.

BATHS.—Baths may be regarded as *simple* and *composite*, *medicated*, or *artificial.* They may be used in the form of liquid, vapour, or air. We shall consider them under these heads in the following description.

A. Simple Baths.—**I. Simple Liquid Baths.**

1. *The Cold Bath.*—By a cold bath is meant the immersion of the body in water below the temperature of 70° Fh. Anything below 50° is considered a very cold bath. The first effect of the bath is a sensation of cold amounting almost to shivering, with slight gasping for breath. If the bath is continued for more than two or three minutes, the temperature of the skin is diminished; and if it is protracted, the blood and the subjacent tissues lose a little heat, but this does not generally occur till after quitting the bath. If the cold is intense and prolonged, there is a certain degree of numbness of the skin; while the pulse becomes small, and

may fall from ten to twenty beats in the minute. After a short time (the colder the water the shorter), reaction takes place, bringing redness to the skin and increase of temperature, with a certain amount of excitement; but if the bath be continued, the depression returns. The immediate action of the cold bath is to cause the capillaries to contract and repel the blood from the surface, while by its operation on the peripheral extremities of the nerves, it acts upon the central nervous system. In its more remote effects, the cold bath accelerates the transmutation of tissues, augmenting the excretion of carbonic acid and of urea from the system, and, as a consequence, increasing the appetite.

The body is usually immersed at once in cold water, but the shock of this may be diminished by first using tepid water, and then gradually adding cold to it.

The effect of a cold bath depends much on its duration. Brief immersion, that is for three or four minutes, makes both the depressing and the exciting action less; a longer duration, say of ten to fifteen minutes, increases both actions; but if the bath be very protracted, the continued abstraction of heat produces depression only. The effects of a cold bath are less intense if the bather is able to keep himself in motion, and especially if he swims.

2. *The Warm Bath.*—A warm bath of 96° to 104° Fh. produces no shock to the system; it causes a moderately increased flow of the circulating fluids to the surface, augmenting the frequency of the pulse; and scarcely affects the respiration. There is not the depression or the excitement of a cold bath. It rather retards the transmutation of tissues. With a hot or very hot bath—from 104° to 114°, the central nervous and circulatory systems are more affected. The frequency of the pulse increases greatly. The respiration becomes anxious and quickened. The skin is in a hyperæmic condition, and a free perspiration breaks out.

3. *The Tepid Bath.*—Tepid baths of the temperature of 85° to 95° Fh., are intermediate between cold and warm. Their effects seem to be confined to the peripheral extremities of the nerves, and they do not excite the nervous centres or the circulatory system. Neither the pulse nor the excretions and secretions are affected. As no heat is confined in the system or taken from it, there is no reaction, and the body temperature is unaltered.

It need scarcely be said that drying and rubbing after a bath materially assist its action on the skin; or that, according to circumstances, it may be convenient to order a whole bath, a hip-bath, or a slipper-bath. The foot-bath is a very useful and convenient one, especially when some stimulant substance is added to the simple water. Wet packing and the various processes of hydropathy, and those powerful agents hot and cold affusion, whether as shower-baths or as douches, are described in the article on HYDROTHERAPEUTICS.

The *duration* of a bath must depend on a variety of circumstances—for instance, on the age and constitution of the patient, on the nature of his malady, and on the temperature of the bath. It may vary from a few minutes to many hours. A very hot or a very cold bath can be supported for a much shorter time than a tepid one.

ACTION AND USES.—Cold baths are indicated for the strong, for youth, and for manhood; warm baths for the delicate, for women, for early childhood, and for old age. Tepid baths are suitable for almost all constitutions, sexes, and ages. Cold baths may, in a general way, be considered tonic and bracing; they are useful when judiciously employed in many nervous affections, as in chorea and hysteria, and they are the best of all for general hygienic purposes. Of late years they have been specially employed in the treatment of fever (*see* TEMPERATURE). The great value of warm baths, besides their hygienic employment, as better detergents than cold ones, is in soothing and reducing excitement; in relieving spasms, such as colic and retention of urine; in the convulsions of children, combined with the affusion of cold water on the head; in cases of gout and rheumatism; and generally when action on the skin is desired. Where prolonged immersion is wanted, tepid baths are indicated, as in calming many chronic nervous disturbances, and in many cutaneous affections.

As to contra-indications, all baths, and especially prolonged and even tepid baths, are not suited for the asthenic. Both hot and cold baths are to be avoided where there is a weak, fatty heart, or any tendency to apoplexy. No one should ever enter a cold bath when exhausted, and such baths are also contra-indicated when there is a tendency to congestion of internal organs. Under such circumstances a warm bath is usually both safer and more refreshing. The too long and too frequent use of hot baths is debilitating.

II. The Simple Vapour Bath.—A vapour bath is one in which the skin is exposed to the action of hot water presented in the form of vapour. The vapour bath may be taken in a box with the head included or not; or in the more common form of the Turkish or Russian baths, where a large room is filled with vapour, and where therefore the vapour is inhaled; or by vapour obtained from a small and suitably constructed apparatus, which vapour may be diffused over the whole body or directed to a particular part. A very simple apparatus for the vapour bath may be prepared by placing under a chair a shallow earthenware or metallic pan, containing boiling water to the depth of three or four inches, and from which abundant vapour can be obtained by placing in it one or two red-hot bricks. The patient sitting on the chair, surrounded by blankets and other suitable covering, will receive the full benefit of a vapour bath. Vapour baths produce profuse perspiration, and act in cleansing the skin much as hot-water baths do, only more powerfully. Vapour being a slow conductor, does not act so fast on the body as water. Vapour baths can be borne hotter than warm-water baths, but their use cannot be continued so long, as vapour interferes with radiation of heat from the body. In such baths a heat of more than 122° Fh. is not borne comfortably. The vapour bath, though falling considerably short in temperature of the air bath, raises the heat of the blood somewhat more. The great virtue of these baths lies in their sweat-producing properties. The average loss of perspiration by the use of a Russian bath has been set down at from ⅔ lb. to 3 lbs. In the Russian bath a slight degree of stimulation of the skin is caused by switching it with twigs of birch, and the alternation of depression and excitement of the cold bath is obtained by placing the patient, when in a state of profuse perspiration, under a douche of cold water.

III. The Simple Hot-Air Bath.—There are two forms in which the hot-air bath is administered: according as the patient does or does not breathe the heated air. The action of the former closely resembles that of a vapour bath, but differs from it in not impeding the respiration, as the latter does by depositing moisture in the bronchial tubes. The lungs, instead of requiring to heat up the inspired air, are subjected to a temperature above their own. Hot-air baths favour the highest degree of perspiration, while the moisture of vapour baths somewhat retards it. If they are very hot, they raise the temperature of the body by several degrees.

As the arrangements for vapour and hot-air baths are practically the same (except that in the latter it is attempted to exclude all vapour from the *calidarium* or *sudatorium*, the hottest room), the following description of an ordinary hot-air bath, the arrangements of which are closely copied from the Romans, will answer for both.

The patient, after unclothing, first goes into the *tepidarium*, which has a temperature of 113° to 117° Fh., in which he remains until the perspiration bursts forth, which happens in from twenty-five to forty minutes. He next proceeds to the hottest room or *calidarium* (in which the air is heated by hot-air pipes which are inserted in the walls), of a temperature of 133° to 140° Fh., and remains there until the perspiration runs down his skin, in twelve to eighteen minutes. An attendant then rubs off the perspiration with a woollen glove, and kneads all the muscles for four or five minutes. The patient next betakes himself to the *lavacrum*, where he has water poured over him of the temperature of 81° to 86° Fh.; next, the whole body is soaped over, the suds are rubbed off, and the patient goes to the *frigidarium*, where he lays himself on a couch and waits till his skin is completely dry. This may occupy twenty-five to thirty minutes, when the patient dresses and leaves the bath greatly refreshed.

Such is a brief account of these baths, the revived use of which is at present so general. The arrangements vary in detail. For ordinary purposes it is easy to furnish either vapour or hot-air baths. A great variety of apparatus have been invented for this purpose, which resolve themselves into this, that the patient should lie in bed or on a seat, and have the bedclothes or other covering secured from contact with him by the employment of a framework or cradle. Beneath this hot air or vapour is introduced, either directly or indirectly, from a suitable apparatus.

The Sand Bath.—We may here mention baths of sand, which are a very old remedy. Of late years establishments for supplying them have sprung up in various towns. They are a convenient way of applying dry heat either locally or generally, and are employed in chronic rheumatism. Bags filled with heated sand (or salt) are useful in hospital and in domestic practice.

Uses.—Both hot-air and vapour baths are indicated when increased action of the skin is desired. They are used most for the cure of catarrhs, of neuralgic and rheumatic pains, and sciatica. They have also been much employed for reducing obesity. They are useful for general hygienic purposes, but are apt to be given too indiscriminately. Hot-air and vapour baths are often locally applied with great advantage to a hand, or leg, or arm, in rheumatism or thickened joints.

B. Composite, Medicated, or Artificial Baths.—A great variety of substances have been used in baths at different periods. We must confine ourselves to such as are at present in use and appear to be of real value, omitting even some that are employed, such as baths of iodine, of iodide of potassium, of iron, of fermented grapes, and of whey.

I. Composite Liquid Baths.

1. *The Sea-Water Bath.*—The average amount of salts in sea-water may be set down at 3 per cent.; this may therefore be considered a suitable strength for ordinary salt baths. The quantity commonly used in London hospitals is about 9 lbs. of salt to 30 gallons of water. Some use bay salt, others Tidman's. Owing to the high price of sea-salt in inland continental places, various natural salts, some of them containing a comparatively small amount of chloride of sodium, have been suggested as substitutes; and also, for economy's sake, 22 to 25 gallons have

been set down as a minimum amount of water for the bath of an adult. The value of these substitutes can only be determined by observing the degree in which they stimulate the skin. Apparently it does not matter much what particular salt is employed to produce the stimulation. A salt bath can of course be increased to any strength by the addition of salt, or of the mother lye as it is termed.

The chief uses of salt-water baths are as tonic remedies, especially for the young, when there is any tendency to scrofula or chlorosis; also in convalescence from many diseases.

2. *Alkaline Baths.*—Alkaline baths may be made by adding 6 ounces of crystallised carbonate of sodium, or 3 ounces of carbonate of potassium, to 25 or 30 gallons of water. Alkaline baths are of use in a great variety of cutaneous affections.

3. *The Corrosive Sublimate Bath.*—Baths of corrosive sublimate are occasionally employed. They are commonly made by adding 3 drachms of corrosive sublimate and 1 drachm of hydrochloric acid to 30 gallons of water. They are employed in some skin-affections, and in secondary syphilis.

4. *Sulphuret of Potassium Bath.*—Baths of sulphuret of potassium are made by dissolving from 4 to 8 ounces of that salt in 25 to 30 gallons of water. A little diluted sulphuric acid is sometimes added. These baths have long been extensively employed in the treatment of cases of skin-disease in which the sulphur they contain is indicated.

5. *The Nitro-Muriatic Acid Bath.*—The nitric or rather nitro-muriatic acid bath is made by adding nitro-muriatic acid to water. The ordinary proportion is one ounce of acid to one gallon of water. The discolouring action on clothing makes a full bath of this kind inconvenient for domestic use, and it is best to take it in a bathing establishment. For the ordinary purposes of a foot-bath at home the old directions of Dr. Helenus Scott, who introduced the use of the acid, are sufficient. The vessel must of course be of wood or earthenware. Dr. Scott added four to six ounces of the acid to three gallons of water. This made a rather strong foot-bath. The patient was to keep his feet immersed for thirty minutes; and the bath was to be repeated every other day for two or three weeks. The axillæ, the groin, and the region of the liver were to be sponged with the acid solution. The bath causes slight tingling of the skin and a taste in the mouth, and is believed occasionally to produce salivation. This bath has been used very extensively in India and in England in liver affections. There is difference of opinion as to its value; many have great confidence in it.

6. *The Bran Bath.*—The bran bath is made by boiling four pounds of bran in one gallon of water, straining, and adding the liquor to a quantity of water sufficient for a bath. Such a bath is useful in allaying irritability of the skin, and also in diminishing the stimulating effect of other baths.

7. *The Fucus Bath.*—This is made by adding a decoction of sea-weed, or the sea-weed chopped up, to an ordinary bath; it will become more or less gelatinous if enough be added. Such baths go popularly by the name of *Ozone Baths*; and they contain a certain amount of chloride of sodium and a minute proportion of iodine. They are useful in the same cases as sea-baths.

8. *The Mustard Bath.*—An extremely useful stimulating bath is the well-known mustard bath, which is made by adding a handful or two of mustard to the ordinary hot-bath. The pediluvium is its most useful form.

9. *Pine Baths.*—Baths of the balsam of pine-leaves may be prepared extempore by making decoctions of the fresh leaflets at certain seasons; but the usual way is to add about one pound of the extract, which is prepared from the leaves, and is everywhere for sale—at least in Germany. The extract dissolves in the bath, which is then ready for use; but of late it has been usual to add a small amount of an essence which is also prepared from the leaflets. It floats to the surface of the water, and attaches itself to the person on leaving the bath, and its aroma is grateful. Of course the quantity of the extract to be employed depends on its strength. These favourite baths are now more and more largely employed at all bathing establishments in every corner of Europe. They are slightly stimulant, and are much used in hysterical, rheumatic, and gouty affections, and also as an adjunct to the internal use of mineral waters.

10. *Baths of Conium, Lavender, &c.*—Aromatic or sedative baths are prepared by adding a decoction of lavender, hyssop, or conium to an ordinary bath.

It is scarcely necessary to add that, as a rule, all composite liquid baths should be of a temperature a little above the tepid; and that their strength, and the time that the patient is to remain in them, must be determined by the special circumstances of the case.

II. **Composite Vapour Baths.**—Vapour baths impregnated with *fir balsam* are popular, and are considered to be more powerful in their operation than pine baths. The vapour which rises in making the decoction of pine leaves is conveyed to a box in which the patient is enclosed.

Aromatic vapour baths may be given by making the steam of hot water pass through bunches of fresh aromatics (*conium, lavender,* &c.) before reaching the box in which the patient is placed. Such baths may be useful in hysteria.

III. **Composite Air Baths.**

1. *Sulphurous Acid Bath.*—A valuable mode of applying sulphur in the form of a bath is by using its fumes—in other words, sulphurous anhydride. The patient is seated on a cane-bottomed chair, and his body is encircled with a cradle, over which oil-cloth is thrown, the head remaining uncovered. Sulphur is placed on a metallic plate, to the lower surface of which the flame of a lamp is applied, when sulphurous acid is disengaged. This bath is less used in cutaneous affections than formerly.

2. *The Mercurial and Calomel Baths.*—Very similar is the mode of applying the fumes of mercury. Under the chair are placed a copper bath containing water, and a metallic plate on which are put from 60 to 180 grains of the bisulphuret or of the grey or red oxide of mercury. Spirit-lamps are lighted under the bath and under the plate. The patient thus experiences the effects both of aqueous and of mercurial vapour. At the end of five or ten minutes perspiration commences, which becomes excessive in ten minutes or a quarter of an hour. The lamps are then to be extinguished, and when the patient becomes moderately cool he is to be rubbed dry. He should then drink some warm liquid and remain quiet for a time. This has often been a favourite mode of treating secondary syphilis with some practitioners. Calomel, in quantities of from 20 to 30 grains, is administered in a similar manner, under the name of the *calomel bath.* It may be given locally by a suitable apparatus.

IV. **Electrical Baths.**—Electricity is an extremely useful aid in the thermal treatment of paralysis; and Electro-Galvanic Baths are often connected with other bathing establishments, it being a very popular practice to galvanise a patient in water-baths between the poles of a battery. *See* ELECTRICITY. JOHN MACPHERSON.

BATHS, Natural.—*See* MINERAL WATERS.

BATTAGLIA, in the province of Venice in Italy.—Thermal muriated saline waters, with sulphate of lime. *See* MINERAL WATERS.

BEAUFORT WEST, in Cape Colony.—*See* AFRICA, SOUTH.

BED-SORE.—*See* ULCER; and ULCERATION.

BELL-SOUND.—A peculiar physical sign associated with pneumothorax. *See* PHYSICAL EXAMINATION.

BELL'S PARALYSIS (named after Sir Charles Bell).—A synonym for paralysis of the facial nerve. *See* FACIAL PARALYSIS.

BERIBERI.—SYNON.: Barbiers; *Kakke*; and numerous other local names.

DEFINITION.—A disease characterised by anæmia, anasarca, degeneration of muscular tissues, effusion into the serous cavities; debility; numbness, pain, and paralysis of the extremities, especially the lower; præcordial anxiety, pain, and dyspnœa; scanty and high-coloured urine; and in some cases drowsiness or sleepiness.

Beriberi occurs in a chronic and an acute form; in the latter often proving rapidly fatal from exhaustion, syncope, or the formation of cardiac or pulmonary coagula. There are two forms, the wet (*beriberia hydrops*), in which there is a hydræmic condition of the blood and distension of the areolar tissues generally with serum, giving the body a bloated appearance; and the dry (*beriberia atrophia*), in which there is a notable deficiency of fluid in the vessels and in the areolar tissues, and early atrophy of the muscles.

ETYMOLOGY.—The etymology of the word Beriberi is obscure. *Bhér-bheri,* a Hindi word, signifies a sore, a swelling. Some persons believe that it is derived from a Cingalese word *beri*, meaning weakness; *beriberi* signifying great weakness.

GEOGRAPHICAL DISTRIBUTION.—Beriberi prevails endemically in Ceylon; and in India, on the Malabar Coast, and in the Northern Circars, between 13° and 20° N. latitude, extending inland from forty to sixty miles. It is known in other parts of India, probably occasionally all over the peninsula; in Burmah, and the Malayan peninsula; amongst the crews of ships trading to ports in the Persian Gulf, Red Sea, coast of Africa, Bay of Bengal, Singapore, China, Siam, and the islands of the Indian Archipelago, and in the Australian seas. On the West Coast and other parts of Africa beriberi also occurs, and is known as the *sleeping sickness.* In Europe *pernicious anæmia* resembles the same disease. Beriberi is also met with in South America, and probably wherever certain conditions of food, water, soil, climate, and mode of life coexist.

ÆTIOLOGY.—All observations tend to show that beriberi occurs where causes of debility have for some time operated, especially in the climates and localities previously mentioned, such as certain conditions of soil, air, and water; exposure to great alternations of temperature, especially when accompanied by wet, fatigue, mental and physical depression; food deficient in quantity and quality or variety; previous exhausting diseases; malaria, and other undefined atmospheric and telluric influences—all, in fact, that tends to depress the vital energies, impoverish the blood, and starve the nerve-centres. As regards a specific origin of the disease, Ogata and de Lacerda claim to have found bacilli in the blood in five out of seven cases of the disease, and to have cultivated them. They are said to be similar to, but somewhat smaller than those of, anthrax; and inoculation of mice, rats, and monkeys is said to have been followed by symptoms characteristic of beriberi. It would be premature, in the present state of the investigation, to regard their causal relations as established. The symptoms, it is said, seldom begin to appear within ten months or a year after first exposure to the exciting causes. Beriberi has been ascribed by Ranking to disease of the kidney, but there is no evidence to prove that it is due to this cause, or indeed to structural changes of any of the viscera. Morehead refers it rather to a scorbutic origin, and in some respects it does resemble scurvy; it may, probably, also, be a consequence of the cachexia that so often results from long residence in a malarious climate, especially when that has been accompanied by exposure, privation, and excessive exhaustion of the vital powers. In such, the most complete anæmia, with debility, may occur independently of the existence of organic visceral disease, though naturally the symptoms will be intensified where such disease is present. An important contribution to our knowledge of beriberi has recently (January 1890) been made by Surgeon Thomas of the Indian Medical Service. He says that, in a very large number of cases he met with, the proximate cause was the presence of ankylostoma duodenale in the intestinal canal, and that the severity of the disease was in proportion to the number of parasites present. He refers to the discovery by Ogata, of Tokio, of a specific bacterium, and to the statement of Drs. Pekelharing and Winkler of Utrecht, that the cause of beriberi is a micrococcus, so that it is an infectious disease.

Anatomical Characters.—Serous fluid is effused generally—in the areolar tissue, in the lungs, brain, heart, and abdominal viscera. The cavities are, like the tissues, soaked with watery effusion. The tissues are soft and degenerate. Muscular fibre is fatty, especially that of the heart, which is often enlarged and dilated. The kidneys are enlarged, anæmic, and softened.

Pathology.—The discovery, by the late Dr. T. Lewis, in India, of the embryo of a nematode worm in the blood of persons suffering from chyluria (*see* Chyluria), lymphorrhœa, and elephantiasis, of which diseases it appears to be, to some extent, the cause, suggests the inquiry whether a similar hematozoon may not also be in some way concerned in inducing beriberi. Fonsagrives and Leroy de Mericourt describe beriberi as general dropsy with a rapid course, weakness and loss of sensibility in the lower limbs, but no albuminuria. Dropsy commences as anasarca, and extends to the serous cavities. Though hepatic, splenic, or renal complications may exist, and intensify the severity and hasten the progress of the general symptoms, they are not essential concomitants of the disease, but appear to originate in a spanæmic state of the blood, and to be kept up by its progressive imperfect elaboration. The resulting partial starvation of the cerebro-spinal nerve-centres, and the serous effusion into and amongst them, sufficiently account for the paralysis which, in severe cases, characterises this disease.[1]

Symptoms.—Beriberi presents itself under a *chronic* and an *acute* aspect, rarely, it is said, occurring in either form until after an exposure of some months to the exciting causes. The general symptoms may be said to be those of anæmia and anasarca. Œdema pervades the limbs and body generally, accompanied with numbness, pain, heaviness, and loss of power, amounting in some cases to paralysis. Along with these symptoms there occur præcordial anxiety, dyspnœa, irregularity and palpitation of the heart, pain at the ensiform cartilage, anæmic murmurs, debility, and a small quick pulse, which at the outset may be rather hard and full, accompanied by dryness and heat of skin. The appetite is at first not impaired.

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[1] Since the present article was written, certain very recent advances in neuro-pathology have made it possible to speak more decidedly on the relation of the nervous system to beriberi. The elaborate researches of Baelz and Scheube in Japan, and of Pekelharing and Winkler in Java, go far to elucidate this matter. In the light of these researches it may be said that, whatever the exciting and predisposing causes may be, the brunt of the disease falls in the first instance, and mainly, on the peripheral nerve-fibres. In beriberi the peripheral nerves are invariably found in a state of well-marked degeneration; and the farther from the cord the more pronounced the degeneration. That the neuritis is of a peripheral character is proved by the absence of degenerative or other changes in the brain, cord, and anterior nerve-roots; and also by the arrest, for the most part, of the degenerative changes at the intervertebral ganglia, which shows that the degeneration is an ascending not a descending one. Pekelharing and Winkler have also shown that the electrical signs of nerve-degeneration can be elicited in cases of impending beriberi during the premonitory stage. Thus beriberi may be defined as a specific endemo-epidemic, multiple peripheral neuritis; and classed with the neurites associated with lead, alcohol, diphtheria, &c., which it so closely resembles. In this way the pathognomonic combination of symptoms may receive a satisfactory explanation: implication of the spinal nerves causes the paresis and anæsthesia; implication of the vaso-motor nerves causes the œdema; and involvement of the vagus, the cardiac plexus, and the phrenic accounts for the laryngeal symptoms, the palpitations, and the breathlessness.—Editor.

Later there is coldness of the extremities; torpor of the bowels; scanty, high-coloured urine, of sp. gr. 1020 to 1040, but no albuminuria as a rule. According to Horton and others, excessive drowsiness and stupor attend some stages of certain cases of the disease; also pale, flabby tongue, and blanched mucous membranes; occasionally hæmorrhage from the stomach and bowels; with petechial eruptions; an anxious look; a puffy, swollen, and sometimes livid face; and a peculiar tottering gait. Death results rapidly in some of the acute cases, with symptoms of effusion into the thoracic and abdominal cavities, or within the skull, by exhaustion, syncope, or the formation of coagula, either in the systemic or in the pulmonic circulation. Beriberi frequently assumes a slight and modified form, indicated by anæmia, numbness, and a certain amount of pain in the limbs; an anxious expression; disordered bowels; scanty urine; cold skin; a low, feeble, and irregular pulse; præcordial pain or uneasiness, with palpitation; nervous depression; an unsteady, almost tottering gait; and a puffy face and neck. Dr. Paul says: 'I have met with a numerous class of cases that are not so serious (as the acute) or so often fatal, where the chief symptom complained of was burning of the feet.' Malcolmson describes this remarkable condition in connexion with beriberi, to which, he says, it is allied—it is found to affect the soles of the feet and calves of the legs, the back, and occasionally the muscles of the legs. It occurs in recent and slight examples of beriberi, and was originally observed in the troops after the first Burmese war—sometimes in men who had not had beriberi. On the whole, Malcolmson thinks it is neither rheumatism nor beriberi, and may accompany or follow other diseases, as an indication of nervous debility.

In the *acute* forms of beriberi the symptoms are very severe and often rapid; and the mortality would indicate it to be second only to cholera in fatality. The chief symptoms are:—Rapid general anæmia and dropsy of the cavities; scanty, almost suppressed urine; constipation; weak, irregular pulse; intense præcordial pain; hurried, irregular, and painful breathing; occasional vomiting—sometimes of blood; swelling of the limbs, with numbness, pain, and paralysis, accompanied by a feeble, tottering gait; and all the symptoms of pleuritic and pericardial effusion; failing heart; and death either from syncope, or perhaps almost suddenly from embolism—in the most acute cases within a few days. In this acute form the affection is very fatal, but in the milder and more chronic form recovery is frequent. Acute symptoms often supervene in those who have suffered from the milder disease, or in those who are exhausted and anæmic from other causes.

Thomas prefers, to the usual classification of beriberi into the wet, dry, and the mixed, the following: *acute*, *sub-acute*, and *chronic*.

The symptoms of the *acute* form are pyrexia, rapid anæmia, and anasarca; dyspnœa; dulness on percussion; cough and expectoration; scanty urine; effusion into cavities, pleural and pericardial; peripheral paralysis well-marked, and great nervous depression.

The *sub-acute* form is characterised by epigastric pain, loss of power in lower extremities, wasting of muscles, loss of irritability, loss of patellar tendon reflex; the face is puffy and swollen; the lower limbs are œdematous; there is tremor of lips and hands; decubitus on back and right side; dyspnœa, vomiting, and jaundice are present; hæmic murmurs are heard over the heart; the apex-beat is indistinct, without signs of hypertrophy or dilatation. Mental debility is marked.

In *chronic* beriberi there is no rise of temperature; the face is puffy, swollen, and livid; there is tenderness of the adductors of the thigh and the gastrocnemius; anæmia, palpitation, and anorexia; the pulse is quick and small; aortic murmurs may be heard; œdema is present in the lower limbs with induration, pain, and numbness. The gait is tottering; the heart is dilated or hypertrophied.

Treatment.—Attention to diet, suitable clothing, and protection against vicissitudes of temperature, wet, and cold, are the best *preventive* measures against beriberi. Bad hygiene and exhausting habits of life tend to promote the development of the constitutional condition in which the disease commences.

When beriberi is established, these precautions are still necessary, and attention must be paid to the symptoms as they occur. Diuretics and diaphoretics relieve the œdema and dropsical effusions. Tonics and stimulants give vigour to the weakened muscular fibre; while appropriate remedies and diet may improve the condition of the blood.

Acetate of potassium, digitalis, and squill, and occasionally calomel, are said to favour the removal of the fluid. It is needless to say that the physiological action of mercury is to be avoided. Salines, hot-air baths, diaphoretics, and turpentine may at various stages be found useful. The object being to remove the fluid and strengthen the muscular fibre, quinine, iron, and other tonics are an important element in the treatment. No remedies, however, will be of much avail unless the patient be placed in favourable hygienic conditions. Malcolmson speaks highly of two remedies—*trĕak farook*, and *oleum nigrum*, which are considered to be very effective in the treatment of the disease, especially in relieving the dyspnœa and œdema, which proved very fatal until these drugs were introduced. The composition of the *trĕak* is apparently generally unknown—it seems to be diuretic and stimulating, and probably not aperient unless combined with rhubarb, in doses of four to fifteen grains. The *oleum nigrum* is a stimulant and diaphoretic, given thrice daily, and has been found by Indian physicians to be very beneficial in some cases of beriberi. Sir William Aitken says that turpentine is a useful remedy. Ergotin, iron, and belladonna with zinc in the form of a pill, accompanied with sea-bathing, were useful in this disease as seen at Bahia. Nux vomica has often been found serviceable in the later stages of certain cases, as might be expected; and opium may be needed to allay pain and irritability. Hepatic and splenic complications need their appropriate remedies. Obviously the chief indications are to regulate the functions of the abdominal viscera; to promote removal of the œdema; to increase the action of the skin; and to give tone and vigour to the muscular fibre. By such measures can we alone hope to deal successfully with this profound form of cachexia.

Thomas believes that the first indication of treatment is the expulsion of the parasites, for which purpose he recommends frequently repeated small doses of calomel, with the administration of thymol to destroy the entozoa; the use of purgatives, also, such as jalap, elaterium; subsequently tonics—iron, quinine, and strychnine. For internal effusion of serum paracentesis may be performed. In some cases pericardial effusion has been beneficially treated by removal of the fluid by puncture with a small trocar and cannula.

Change of climate is of great importance, as well as careful attention to diet and other measures for maintaining or restoring the general health. JOSEPH FAYRER.

BETHESDA SPRINGS, in Waukesha County, Wisconsin, U.S.A.—Calcareous waters. *See* MINERAL WATERS.

BEX, in Switzerland.—Strong muriated saline waters, with some iodide and bromide of magnesium. *See* MINERAL WATERS.

BIARRITZ, in France, on the Bay of Biscay.—A fashionable seaside resort. The climate is considered to be bracing. *See* CLIMATE, Treatment of Disease by.

BILE, Disorders of. — Disorders of the bile held a large place in the medicine of antiquity, with the exception of the theories of Van Helmont and Paracelsus; the latter looking upon the bile as the balsam of life, and therefore incapable of begetting disease; the former regarding it as a mere excrementitious fluid, and therefore equally incapable of begetting disease. Disorders of the bile have, nevertheless, held their own quite into our time. It is common enough to hear persons speak of a 'bilious attack,' or 'being troubled with the bile,' expressions the survivals of the humoral pathology. The liver was formerly credited with most of the dyspeptic disorders of the stomach. But, as Sir Thomas Watson says, it is an organ often blamed most gratuitously and unjustly, but no educated or scientific physician would now think of attributing a gastric catarrh, or constipation, to an 'attack of the bile,' or to a 'sluggish liver.'[1]

Physicians have arranged disorders affecting the bile under three heads—(1) diminished secretion of bile; (2) increased secretion of bile; and (3) secretion of morbid or altered bile. This division may very well be accepted as a convenient basis for the further discussion of biliary disorders, but it is nothing more than an hypothesis. It is likely enough that the bile, in certain diseases, changes its character as regards both its amount and constituent parts; but it cannot be denied that the means by which physicians are able to ascertain these changes can scarcely be said to exist in ordinary cases. A common saying is that the patient must be making plenty of bile because the stools are high in colour. No reasoning can be more fallacious. The colour of the stools may be high if the fæces be quickly swept through the intestinal canal, because there has been no time for the bile-pigment to be absorbed into the blood. Or the fæces may be pale if they lie long in the bowel and the colouring matter is absorbed. So that the colour of the stools is no sure sign of the poverty or abundance of the secretion of bile. In cases of pale-coloured fæces purgatives often do good, not because they have any special tendency to increase the flow of bile, but because they hurry the fæces out of the intestine, and thus give no time for the absorption of the bile, which, if it lay long in the bowel, would be absorbed, carried to the liver, and again excreted into the gall-ducts—the vicious circle of Schiff.

Nor is the analysis of the bile found after death in the gall-bladder of much value. Frerichs announced the presence of albumen in the bile in cases of congestion of the liver; but it is now generally thought that this appearance is due solely to a post-mortem transudation. Ritter also has described a colourless bile in which all the constituents of bile are present except the pigments. Most of his analyses were made on bile taken from the gall-bladder after death; but if the cystic duct be obstructed for any time, it is well known that the bile contained in the gall-bladder may become colourless without any real secretion of colourless bile having taken place in the first instance. It is impossible to be certain that the changes, which are found in the bile taken from the gall-bladder after death, have taken place during life.

The only source of what may be called knowledge of the disorders of the bile is observation of men or animals in whom biliary fistulæ have been formed either by disease or by art. Unfortunately, the majority of such observations have been physiological or pharmacological; and but few are recorded of the changes which the bile undergoes in disease. Altogether contradictory experiments are recorded of the influence of the nerves and of the diabetic puncture of the fourth ventricle upon the secretion of bile. It is an admirable field for further research, but it will be seen that our present knowledge very closely approaches to complete ignorance.

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[1] The opinion of this eminent physician is nevertheless open to question.—EDITOR.

It is disputed still whether the presence of bile in the stomach puts an end to the process of digestion. By many it is thought that the bile-acids throw down the albumen of the food, and with the albumen the pepsin. It is well known that in some disorders there is an inverted action of the duodenum, and bile is poured into the stomach, as in long-continued vomiting, for instance; thus the dispute has a practical bearing. The best treatment of this state would seem to be by saline purgatives.

Bile may also be taken up into the blood, and when this occurs, jaundice results. *See* CHOLÆMIA; and JAUNDICE.

J. WICKHAM LEGG. STEPHEN MACKENZIE.

BILHARZIA.—The name given (by the late Dr. Cobbold) to a genus of flukes, discovered by Dr. Bilharz, of Cairo. *See* ENTOZOA.

BILIARY CALCULUS.—*See* GALL-STONES.

BILIARY FISTULA.—There are two kinds of biliary fistula:—one, in which a communication exists between the gall-bladder and the surface of the body; the other, in which there is a communication between the gall-bladder and other internal organs. Neither kind is common, but the first is less rare than the other.

In the first variety a tumour forms, sometimes in the place of the gall-bladder, at other times near the umbilicus, in the linea alba or to the left of this line, or in the groin. The tumour, if opened spontaneously or by the surgeon, discharges a quantity of pus, bile, and gall-stones. If the cystic duct be obliterated, no bile need escape. A suppuration of the gall-bladder, caused by the presence of gall-stones, is the common cause of these fistulæ. The prognosis is good. The diagnosis, before the tumour opens, is very difficult. In a case which came under the notice of one of the writers, it was mistaken for an abscess of the liver.

In the second kind of biliary fistula, the gall-bladder may communicate with the duodenum or colon; with an abscess of the liver; with the portal or other abdominal vein, though it must be owned that cases of this kind seem somewhat dubious; or with the urinary bladder, or at least with some part of the urinary tract. Gall-stones are in nearly every case the cause of the fistulous opening.

J. WICKHAM LEGG. STEPHEN MACKENZIE.

BILIER, in Bohemia.—Cold acidulated alkaline waters. *See* MINERAL WATERS.

BILIOUS.—This term is used with much vagueness, and in popular language is often employed very incorrectly, though the general notion is to associate it with conditions in which an excessive formation of bile is supposed to occur. The chief uses of the word are as follows:—In the first place it is employed to designate a peculiar temperament—the *bilious temperament.* Again, individuals are often said to be *bilious* when they present a sallow or more or less yellowish tint of skin, but especially if they are distinctly jaundiced. *Bilious vomiting* and *diarrhœa* signify respectively the discharge of a quantity of bile, mixed with vomited matters or with loose stools. Certain febrile diseases, attended with yellowness of the skin, are sometimes designated *bilious fevers*; and under like circumstances pneumonia has been described as *bilious pneumonia.* Lastly, one of the most frequent applications of the term is to certain so-called *bilious attacks* or *biliousness*, which, however, are commonly merely attacks of acute dyspepsia or of migraine. The most prominent symptoms of a supposed *bilious attack* are anorexia, furred tongue, a bitter taste, sickness, constipation, and headache, with a feeling of marked depression and general malaise. Such attacks are most effectually prevented by careful regulation of diet, and the avoidance of exposure to cold, fatigue, and undue mental exertion or anxiety; when they come on, abstinence from food is desirable, with rest in the recumbent posture, and perfect quiet. Cholagogue aperients and saline effervescents may be given, alcoholic stimulants being avoided as far as possible.

FREDERICK T. ROBERTS.

BIRTH PALSIES.—*See* PARALYSIS.

BITTER ALMONDS, Poisoning by.—*See* PRUSSIC ACID, Poisoning by.

BLACK VOMIT.—Vomited matters may be more or less black in different diseases, but the peculiar *black vomit* is that which occurs in yellow fever (*see* YELLOW FEVER). The rejected matters are acid in reaction, and a sediment is deposited of coagulated albumen and disintegrated blood-corpuscles. Ammonia is also present. The black colour of the vomit has been attributed by some writers to altered bile, but there can be no doubt that it is due to its admixture with blood which has undergone certain changes

BLADDER, Diseases of.—Synon.: Fr. *Maladies de la Vessie*; Ger. *Blasenkrankheiten.*

The bladder may be the seat of the following morbid conditions:—Inflammation, acute or chronic; Abscess; Neuralgia; Atrophy or Hypertrophy; Mechanical Distension, with chronic engorgement and retention of urine, commonly, but erroneously, termed 'Paralysis'; Sacculation; Displacements, such as hernia in the male, or, very rarely, inversion and protrusion in the female; Tumours or Growths of various kinds, from simple Mucous Polypi to Epithelioma, Sarcoma, and Carcinoma; Tubercular Disease; Ulceration, either simple or malignant; and Vesico-vaginal or Vesico-intestinal Fistula. The bladder may also be the subject of true paralysis, partial or complete, as the result of injury to the brain or spinal cord, or following disease of those organs.

Only a brief statement respecting the most important of this class of affections need be presented here, in order to facilitate an acquaintance with their diagnosis, since the treatment of almost all of them belongs to the province of the surgeon, and so far only as it consists of medicinal remedies will the subject be considered.

1. Acute Inflammation—Acute Cystitis.—The mucous lining of the bladder is the part affected by inflammation; and although, after long and severe attacks, some morbid action occurs by extension to the muscular coat, or even to the peritoneal covering, these structures are very rarely affected. An acute inflammation of a very severe kind occurs from injuries; from the presence of instruments, foreign bodies, or calculi; and from unrelieved retention of urine. A less severe, somewhat evanescent, but very painful form of cystitis arises from irritants taken internally, as cantharides. A still less severe but often troublesome form originates by extension from gonorrhœa.

In the *first* class of cases there are not only severe local symptoms referable to the bladder, but the general system may be gravely affected.

In the *second* class, of which cantharides-poisoning is the type, the phenomena of very frequent, painful, and spasmodic attempts to eject small quantities of urine, which is often bloody, occur within a very short time after absorption of the poison. A common blister is said to produce the affection in some persons. In two cases—the only two the writer has seen—it has followed the application of a blister to a surface already partially denuded of the scarf skin. In one of these a blister was applied to a knee which had been frequently painted with tincture of iodine, and was still slightly sore. In three hours after the application the patient was attacked with exceedingly painful efforts to micturate, which were at times intense. The attack lasted six hours, gradually diminishing in force, and leaving no ill-effects behind. In less than twenty-four hours no trace of the symptoms remained.

In the *third* form of cystitis, which is the most common, and of which that arising by extension from gonorrhœa may be taken as the type, the usual symptoms are undue frequency of micturition; a necessity to perform the act immediately the want has declared itself, a condition conveniently expressed by the single word 'urgency'; a desire to pass more, accompanied by pain, when all the urine has been voided; and some dull aching over the pubes; together with a general febrile state of the system, often very slight, but corresponding for the most part with the degree of local inflammation. The urine itself is cloudy, and deposits some light mucus on standing, but it is not otherwise apparently altered. Under the microscope abundance of epithelium is visible, as well as some pus-cells; and if the affection is severe, a few blood-corpuscles are also present. It may be remarked here that the presence of a few pus-cells in the urine—a fact to which so many practitioners attribute considerable importance—by no means necessarily deserves to be so regarded. The very slightest attack either of this or of the preceding form of cystitis is certain to be attended by the formation of some quantity, however small, of fully-developed pus-cells.

Very rarely a *false membrane* may be produced on the surface of the mucous membrane of the bladder, and may be thrown off almost entire, leading to the belief that the inner coat has itself been removed or, as it has been termed, separated by 'exfoliation.' In women this membrane has been voided *per urethram* in a condition for examination; in men this cannot occur, because the urethra is too small to admit of it. Now and then examples of the former have been shown at the Pathological Society of London; and one of the latter, discovered on operation, may be seen in the museum of the Royal College of Surgeons, London. *See* Casts.

Treatment.—In the first form of cystitis, the removal of the exciting cause, if possible, is the chief indication.

The treatment of the second form should consist of very hot bidets or hip-baths, the former being sometimes preferable as capable of being used at higher temperatures than the latter; together with large doses of the tincture of henbane, say a drachm, with 10 or 15 drops of liquor opii (Bat.) every four hours while pain is severe; 20 minims of liquor potassæ may be given either simultaneously or alternately, in water or in any bland diluent.

The treatment of a well-marked case of the third class consists in absolute rest in the recumbent posture, mild diet, abstinence from all alcoholic stimulants, gentle laxative action of the bowels, and the administration of small doses of alkali. The writer prefers liquor potassæ, frequently repeated, to all others; and this may be combined with henbane, or, if micturition is very frequent and painful, with opium or morphine, or with belladonna in small doses. Hot hip-baths or bidets, followed by hot linseed-meal poultices or fomentations, give great relief. The patient may drink freely of decoction of triticum repens, linseed-tea, barley-water, or similar demulcents. Relief rapidly follows, but care is requisite to avoid relapse, which easily occurs if exercise be taken too soon, if injections for the gonorrhœa be resumed too readily, or if alcoholic stimulants be indulged in.

2. **Chronic Inflammation—Chronic Cystitis.**— Chronic inflammation of the bladder is separated from the acute form by very distinct characters. It is mostly the result of retained urine from stricture or enlarged prostate; but it may arise from the presence of calculi, or of growths in the bladder; from over-distension, or atony of its coats; from paralysis after injury or disease affecting a nervous centre; from disease of neighbouring organs; and sometimes from altered urine: it is also met with in certain affections of the kidney. Sometimes this condition is marked by the presence of a large quantity of viscous mucus, often called 'catarrh'; but more commonly this symptom is absent, and the urine contains merely ordinary mucus or muco-pus, rendering the secretion more or less cloudy and opaque. Perhaps there are some cases in which the inflammation is mainly due to the existence of gout.

Symptoms. — The symptoms of chronic cystitis are increased frequency of micturition and pain, but the latter is by no means necessarily present. The urine is always cloudy, and contains some pus-cells. There is often, but not always, some supra-pubic uneasiness. The general health does not suffer unless the affection is prolonged or severe. If important causes, as the presence of stricture, calculus, &c., occasion the chronic cystitis, their specific symptoms will predominate. It is not common to find chronic cystitis as an idiopathic disease, although undoubtedly it occasionally is so; so that the writer has always regarded it as a useful maxim, 'When chronic cystitis is declared to be idiopathic, we may be sure that we have only not yet discovered the real cause.' As a general rule we may suspect that there is inability to empty the bladder, or calculus, stricture, or organic disease of some kind in some part of the urinary tract, when the group of symptoms are present which we denote by the term 'chronic cystitis.' Respecting the well-known glairy mucus, which is deposited so abundantly from the urine in some cases, in elderly people almost invariably, it should be said that it appears only in those whose urine is abnormally retained, through atony of the vesical walls, or in consequence of enlarged prostate, or as the result of sacculation of the bladder, and that medicine has little or no effect upon it.

Treatment. — The regular and habitual use of the catheter, and perhaps also injections into the bladder, form the essential mechanical treatment of chronic cystitis in the cases just mentioned. In the few cases in which chronic cystitis is present and no organic cause, such as those named above, can be discovered—and also as adjuncts to mechanical treatment when these causes do exist—certain *medicinal* agents are undoubtedly useful: these are buchu, triticum repens, uva ursi, alchemilla arvensis, pareira, and the alkalis—potash and soda. Buchu is more useful in subacute and recent chronic cystitis than in cases already of long duration. The patient should take not less than ten ounces of the infusion daily. After this, in similar cases, the decoction of triticum repens (made by boiling two to four ounces of the prepared underground stem in water to make a pint and a-half of decoction, of which six ounces are taken three or four times in the twenty-four hours) is highly useful. For more chronic cases, where the urine is alkaline and deposits much mucus, and perhaps the triple phosphates also, alchemilla, uva ursi, and pareira may be very valuable. The alchemilla is administered in infusion, one ounce of the herb in one pint of boiling water, of which the dose is four to six ounces three times daily; the others to be made according to the directions of the Pharmacopœia, but taken in quantities at least two or three times as great as those there suggested. These may be taken alone or combined with potash, which in moderate quantities diminishes the natural acidity of the urine before it enters the bladder; the mucous membrane of which, although accustomed to that condition in health, is perhaps sometimes, when inflamed, irritated by urine of even the ordinary acidity. Whether this be so or not, there is no doubt that alkalis do frequently tranquillise an irritable bladder. They are often given in the form of Vichy water, Vals water, or that of Evian—all strong solutions of soda; but on many grounds the salts of potash are preferable. On the other hand, the mineral acids have been largely administered in cases where the urine is alkaline; although there is no reason to believe that the acid has any direct action through the kidneys, or that it is eliminated by those organs. Alkalinity of the urine in chronic cystitis is almost always due to inability of the bladder to empty itself, and the remedy wanted is not medicine but a catheter, at all events to ascertain whether this be the cause or not. A very small quantity of urine retained in the bladder, say one or two ounces, after every act of micturition, suffices in some cases to maintain an alkaline and otherwise unhealthy state of the secretion; while it is equally true that some patients may habitually, and during long periods of time do, fail to empty the bladder, always leaving behind from half a pint to a pint, without the urine losing its acidity. Of course other signs, and notably great frequency of micturition, are present when such is the case.

3. **Neuralgia.**—It is impossible to deny that the bladder may be subject, like other parts of the body, to symptoms which are described as neuralgia, although the occurrence is an extremely rare one. All the writer can say is, that he has occasionally met with cases in which he has not been able to account, by the existence of any lesion, for pain and frequency in micturition, or for difficulty in performing that act, and where these symptoms have been more or less periodic in their appearance. In such instances he has given quinine, and has occasionally found great relief to follow a few doses; more frequently this has not been the case. But now and then the value of the drug has been so marked as to corroborate a belief in the existence of vesical neuralgia. It must be repeated, however, that examples of such phenomena are extremely rare. The writer has also employed arsenic on the same ground. It is invariably necessary to investigate the general health, as well as the habits and diet of the patient. This, perhaps, may be the place for stating that in all chronic and slight deviations from natural and healthy function in the urinary organs, it is essentially necessary to inquire into the state of the digestive organs, and, if possible, to correct by diet, and by medicine when necessary, any imperfect action on their part. Constipation alone, when habitual, may produce considerable irritability of the bladder, a slight affection of the organ already existing; so also may the unnecessary use of purgatives. A gentle, easy, and daily action of the bowels, a healthy condition of the primary digestion, the absence of flatulence and distension after food, should be ensured as far as possible in all patients complaining of frequent, difficult, or uneasy micturition; and many such may be completely cured of so-called urinary affections by strict attention to these matters. The writer's strong convictions relative to this fact, grounded on innumerable experiences of its value as an aid in practice, led him, upwards of twenty years ago, to ascertain the great value, for such patients, of the natural aperient waters of Germany and Hungary, now so extensively used; and he now more than ever insists on the use of a mild and laxative regimen and careful diet in their management.

4. Where obstruction to the outflow of urine exists (stricture of the urethra, most forms of enlarged prostate, other tumours, &c.), the muscular walls of the bladder become the seat of **Hypertrophy,** which is a condition of compensation, therefore, and not of disease in or by itself. But such changes in the interlacing muscular fibres existing, **Sacculation** readily occurs, by protrusion of the lining membrane between the bands so produced. On the other hand, most commonly when the prostate is much enlarged, the bladder becomes gradually distended, its coats become expanded, thinned, and weakened, and a certain degree of **Atrophy** takes place. The power of the organ to expel urine is lost or diminished; and micturition being a function of a simply mechanical nature, the circumstances of the case demand only a mechanical remedy, viz. the catheter. No medicine can restore power and exercise of function under these circumstances. But atrophy and loss of power may occur from complete or partial loss of nervous influence over the bladder, as in those who are the subjects of paralytic states commencing in the spinal cord or brain. When the paralytic state follows an accident causing injury to a nervous centre, the nature of the case is obvious enough. But sometimes the onset and progress of chronic disease in these organs are very slow and insidious; the urinary troubles, as manifested by slowness or difficulty in passing urine, or by urine clouded through inability of the bladder to empty itself, may be the earliest signs of the nervous lesion. On the other hand, impaired gait, and other evidences of central mischief, may be (and mostly are) earlier phenomena, the derangement in the urinary function appearing at a later stage. For such patients, the habitual use of the catheter is often necessary (always of course when unable to empty the bladder by the natural efforts); while such constitutional treatment as is indicated by the cerebral or cerebro-spinal lesion present will comprehend that which the bladder demands. It is therefore unnecessary to allude further to that subject in this article. The same remark also applies to those few examples of **Tubercular disease** of the urinary organs, which is always a local expression of a general constitutional state sufficiently considered under its proper head in this work. All other treatment of this malady is local and surgical.

5. **Tumours.**—Tumours of the bladder have received much attention during the last few years, and the classification here offered is founded to a great extent on the writer's own experience, which has been considerable. Besides examining in consultation not a few cases, as well as taking the supervision of others in which, for varying reasons, no surgical procedure was admissible, he has operated for the removal of vesical tumour on upwards of forty patients. From these, from a study of the numerous preparations in the London museums, and from the growing experience of others, the following

varieties may be enumerated and classified, commencing with the most simple.

(1) *Mucous Polypus.*—Mucous polypus is not to be confounded with prostatic outgrowths of the same form, these being inadmissible in any scheme comprising vesical tumours. It resembles polypus of the nasal cavity, but is more compact and solid in structure. Hitherto this product has been found in young children only.

(2) *Papillomatous Tumours.*–These appear in two forms. The essential character of each is that it closely resembles the natural papillæ occurring in certain parts of the digestive canal; the structure consisting of a prominence of simple membrane supported by a little connective tissue, but containing a large arterial twig as a central axis, the outer surface of the membrane being closely covered by a layer of cylindrical epithelium, or less commonly by an ovate or rounded variety. Formerly these growths were termed 'villous,' to which it was not unusual to add the word 'cancer,' although the implied allegation was entirely without warrant. When slender, long, and floating in the bladder, a papillomatous growth is termed 'fimbriated'; when more fibrous tissue is present and the growth is more solid, 'fibro-papilloma' appears to be the more appropriate term. These growths form very slowly at first, but when developed give rise to repeated attacks of hæmorrhage, which in time becomes continuous and copious, thus terminating life. They are the most commonly met with of all vesical growths, and their symptoms have been often mistaken for those of renal disease. Microscopic examination of the urine will sooner or later (especially if the bladder is washed out with water and the *débris* scrutinised) detect specimens of the growth which are quite characteristic. Moreover, on careful inquiry it may be ascertained that the bleeding is found occasionally, sometimes frequently, to appear in a manner which can rarely or never be met with in renal hæmorrhages. The patient commences an act of micturition with clear or almost bloodless urine, and at the end of the act, bright florid blood is mixed with the stream or appears alone at the close. This fact determined, the bleeding is without doubt vesical, and if little pain is complained of, as a rule the bleeding is certainly not due to a sarcomatous or carcinomatous growth, and is therefore probably a sign of papilloma.

The writer knows no styptics that beneficially affect hæmorrhage from this source, although he has seen all the known remedies abundantly tried. Preparations of iron, especially the perchloride, have the best claim perhaps to be employed. Treatment by local injections is apt to provoke rather than check the flow of blood.

(3) *Simple Myomatous Tumours.*—These are not common, and are not accompanied by any characteristic signs of their presence. Nothing further remains to be said of them here in relation to diagnosis.

(4) *Tumours made up of Fibrous Tissue.* This kind of vesical tumour consists chiefly of fibrous tissue, more or less associated with small nuclei interspersed; sometimes the nuclei are in large quantity, a fact which leads to a graver estimate of their character.

Both these and the preceding kind of tumour involve the deep structures of the organ, and cannot be removed entirely by operative procedures; on the other hand, the simpler forms of papilloma, especially when growing from a pedicle, may be completely removed, and often do not return.

(5) *Epithelioma.*—The nature and characters of epithelioma of the bladder are the same as those of this growth in other parts of the body. This and the two following will be considered together.

(6) *Scirrhus.*—'Cancer,' properly so called, not occurring until after the middle term of life has been reached, is occasionally met with in the bladder.

(7) *Round- and Spindle-celled Sarcomata.* These were formerly known as 'encephaloid' disease. They are most commonly met with in children; although occasionally in the adult also.

Diagnosis.—The diagnosis of malignant disease of the bladder is not difficult. Examination of the rectum furnishes valuable information. Scirrhous growth is very hard, irregular in form, and thus unlike any simple prostatic enlargement occurring in elderly men. The sarcomata are full and rounded in form, more elastic to the touch than 'prostatic enlargement,' and far more rapid in their rate of increase. Epithelioma, slow and restricted in its growth, may exist some years before presenting a tumour sufficiently dense to be recognised by palpation or sounding. In malignant disease pain is soon a more or less constant symptom, and some hæmorrhage is liable to appear, increasing at a later date; contrasting with papilloma, which latter is rarely recognisable by the rectum, commences with hæmorrhage, and is rarely painful. The progress of epithelioma is slow, and without any very distinctive characters. In all these three forms of recurring growth, microscopic observation may corroborate a diagnosis based on the symptoms, but cannot by itself establish one.

Treatment.—In relation to surgical treatment of the malignant diseases of the bladder, nothing can be said in behalf of operative measures for their removal. It is always impossible to extirpate the disease, which largely involves the organ itself, and rapidly reappears after the attempt has been made, although large masses may have been taken away, and an apparently almost empty cavity has been left as the result of the procedure.

The palliative treatment for all patients thus affected consists in the avoidance of habits, occupations, and any amount of exercise found, by the experience of each individual case, to produce serious increase of hæmorrhage. The maintenance of the digestive power, and healthy activity of the functions which support life, are as far as possible to be ensured. Lastly, all means should be adopted, especially towards the closing stage of a case which is certainly destined to be fatal, to alleviate suffering, which is usually severe and prolonged, unless dealt with unflinchingly, as it ought to be, in such painful circumstances. Ample use should be made of morphine, usually most effective by subcutaneous injection, so that, although unable in any way to check the progress of the malady, we may at least mitigate the most terrible accompaniment of its distressing and inevitable course.

With almost all affections of the bladder, simple or malignant, ulcerative or associated with fistula, cystitis to some extent and in some form co-exists. It is this which gives rise to the presence of an undue quantity of mucus in the urine; it is often the source of pus, sometimes of blood in small quantity. Thus, in all the above-mentioned diseases, some degree of cystitis appears sooner or later. HENRY THOMPSON.

BLADDER-WORMS.—A general term embracing various parasitic entozoa, having the character of cysts or vesicles. *See* ENTOZOA.

BLANKENBERGHE, in Belgium. A sea-bathing resort. *See* CLIMATE, Treatment of Disease by.

BLEB.—A large vesicle or bulla, containing, for the most part, a serous fluid, as in pemphigus, erysipelas, or burns and scalds. *See* BLISTER.

BLENORRHŒA, BLENORRHAGIA (*βλέννα*, phlegm; and *ῥέω*, I flow. *βλέννα*, phlegm; and *ῥήγνυμι*, I burst out).—These terms are most correctly used to express excessive flow of mucus from any mucous surface. By means of an affix, the locality or nature of the discharge is expressed: *e.g. blenorrhœa oculi, nasalis, urethralis.* More commonly, however, and less accurately, blenorrhœa is employed as synonymous with gonorrhœa in the male or female.

BLEPHARITIS (*βλέφαρον*, an eyelid).—Inflammation of the eyelids. *See* EYE AND ITS APPENDAGES, Diseases of.

BLEPHAROSPASM (*βλέφαρον*, an eyelid; and *σπάσμα*, a spasm).—Spasmodic movement or contraction of the eyelids. *See* EYE AND ITS APPENDAGES, Diseases of.

BLINDNESS.—Loss of sight. *See* AMAUROSIS; and VISION, Disorders of.

BLISTER.—SYNON.: Bleb; Blain; Fr. *Bulla; Bulle*; Ger. *Blase.*

DEFINITION.—A vesicle of the skin, caused by the separation of the horny cuticle from the rete mucosum by the transudation of serous lymph beneath the former.

ÆTIOLOGY.—Blisters may be idiopathic, as in pemphigus; or symptomatic, as in erysipelas. They are met with under the influence of any cause which depresses the vitality of the integument, as in some forms of prurigo, in chilblain, and in carbuncle; in scalds and burns; and as an effect of powerful irritants, such as cantharides or the aniline salts.

DESCRIPTION.—A blister ranges in size from that of a pea to a turkey's egg; it is more or less convex according to the amount of exudation; and conforms in colour with that of its contents, being sometimes yellow or amber-coloured and transparent, like serum, sometimes opalescent from the presence of pus, and sometimes red or purple from admixture with blood. The fluid of a blister, generally limpid and free, is sometimes held in the meshes of a delicate network, resulting from the stretching of the connecting cells of the rete mucosum and horny epidermis. This is peculiarly the case in blisters developed under the influence of acute inflammation, and especially in dermatitis anilina. Blisters may be dispersed, or aggregated, or even single, as in pemphigus or pompholyx solitarius.

TREATMENT.—Blisters when idiopathic are essentially asthenic in their nature, and call for corroborant therapeutical treatment. Locally they should be punctured so as to admit of the gradual escape of their contents, and then dusted over with some absorbent powder, such as oxide of zinc, fuller's earth, or cinchona. ERASMUS WILSON.

BLISTERING.–A therapeutic measure, which consists in the artificial production of blisters on the skin. *See* COUNTER-IRRITATION.

BLOEMFONTEIN, in the Orange Free State.—*See* AFRICA, SOUTH.

BLOOD, Abstraction of. — SYNON.: Bleeding; Blood-letting; Fr. *La Saignée*; Ger. *Der Aderlass.*

DEFINITION.—The withdrawal of blood from the body, either (*a*) from the general circulation, by arteriotomy or phlebotomy; or (*b*) locally, by leeches, scarifications, or wet-cupping.

It is to the first two of these methods of abstracting blood that the term 'bleeding,' or 'blood-letting,' has by common usage been restricted.

The topical abstraction of blood by means of leeches, scarifications, and cupping, though often valuable, is of secondary importance.

The present article will, therefore, chiefly be devoted to *general bleeding*.

General Bleeding.—This art, practised for centuries more or less universally, has of late years in this country fallen into disfavour. Much discussion has been raised as to the grounds for so great a difference. It has been attributed—(1) to the type of disease having undergone a change; (2) to mere fashion or caprice; (3) to a better knowledge of the nature of disease, teaching us that its processes were of a lowering or depressing character, which were to be overcome by the more general use of drugs which control the circulation, as well as of stimulants and support. It is probable that several causes have contributed to the undoubted change which has taken place. The year 1830 and subsequent years were marked by the epidemic visitation of cholera and of influenza. These diseases were characterised by extreme depression.[1] If antiphlogistic measures were adopted, they proved failures, and taught the physician that blood-letting was not the universal panacea it was supposed to be. By degrees it ceased to be practised as it used to be. A new generation which knew not the past has sprung up; and, as in all reactionary movements, the practice has become at length as limited as it formerly was universal. It is almost certain that in either extreme there is an evil, and that we may have recourse in certain cases to abstraction of blood with some degree of that success which formerly led to its extensive use, if not its abuse. It will be well to consider the subject at some little length, and under the following heads:—

1. The effects of moderate losses of blood on the healthy economy.

2. The value of bleeding as a remedy in disease, together with the indications for its employment in various affections.

3. The method of performing the operations of opening an artery—arteriotomy; and opening a vein—phlebotomy.

1. EFFECTS.—We have first, then, to consider the effects of moderate losses of blood upon the healthy economy. Upon this point we have abundant evidence, for the custom of regularly bleeding healthy people had reached such a point during the earlier part of this century, that in country districts it became a habit for adults to be bled as regularly as they went to market. No better testimony regarding the effects of this practice could be adduced than that of Sir James Paget, who, when referring to these customary venesections, says: 'I can regard those as a series of venesections fairly performed for the determination of what is the influence of the removal of blood up to the point of syncope upon a comparatively healthy person. I think I can say surely that not one of these persons suffered harm.' To this might be added other and abundant testimony to the harmlessness of moderate venesection on the healthy economy.

2. INDICATIONS AND USES.—Concluding, then, that the abstraction of a limited quantity of blood has no deleterious effect upon the healthy organism, we will next describe the general indications for the use of bleeding in disease, and briefly refer to the various affections in which it may most suitably be employed.

Broadly stated, it may be said that bleeding is indicated when there is evidence of marked over-distension either of the arterial or of the venous system. In either case the result will be cardiac distension—in the former case of the left, and in the latter of the right chambers of the heart. In such conditions general bleeding restores the lost equilibrium of the vascular system, and relieves the heart and the other parts concerned in the circulation of the blood.

The arterial system may be in a state of augmented tension from two causes: (1) contraction of the arteries (the smaller vessels) themselves, with a diminished amount of blood in the arterial system; and (2) engorgement or distension of the arteries from spasm of the arterioles: both may be regarded as vaso-constrictive neuroses. In the first case there may be engorgement of the venous system and embarrassment of the right heart, calling for abstraction of blood by *venesection*; or visceral fluxion, the skin being pale: in the second case, relative emptiness of the veins with overfulness of the larger arteries, calling for blood-letting by *arteriotomy*.

In the former condition there would be, in bedside language, a *small* hard or wiry pulse, and in the latter a *full* and hard or bounding pulse. In the former the surface of the body may present one of the two following conditions: either the skin is injected and perhaps dusky, and this appears to be the case ordinarily; or it is pale and cool, the blood having receded inwards, chiefly to the abdominal viscera. The second condition obtains and is well seen in cases of uræmic asthma, when the arterial system is turgid almost to bursting, while the veins are comparatively empty. 'Hardness' of the pulse is usually said to be an indication for bleeding, and in certain associations it is so; but it is necessary to discriminate carefully between the 'hardness' due to 'tension' of the sound artery arising from (*a*) excessive contraction (the small, hard, wiry pulse), and (*b*) overfulness (the full, bounding pulse) on the one hand; and that due to arterial degeneration with more or less hard deposit in the walls of the vessels, on the other. In doubtful cases inquiry should be made into the state of the brachial artery at the bend of the elbow. This can readily be done by flexing the limb, when, if calcareous degeneration have taken place, the vessel will be thrown into serpentine folds, visible, except in fat people, to the eye, and cord-like and rigid to the touch. The temporal artery is a less safe guide, but neither it nor an arcus senilis should be overlooked in this connexion. A visible and tortuous pulse in a young person may indicate aortic regurgitant disease: the age of the patient must therefore be taken into consideration.

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[1] This state of depression was especially remarkable during the influenza epidemic of 1890, even in cases in which the ordinary symptoms of the disease were not severe; so too was the persistency of its effects.—EDITOR.

Dilatation of the arterioles would permit of the rapid passage of arterial blood into the veins: under such circumstances, therefore, we should expect the blood issuing from a cut vein to present a more florid appearance than under ordinary conditions. Bleeding here should be undertaken with considerable circumspection, and not be pushed very far, for collapse out of proportion to the amount of blood abstracted might ensue. On the other hand, when there is spasm of the arterioles, and the abstraction of blood is deemed advisable, it would be well to resort to arteriotomy rather than venesection. The best guide here would be the sphygmograph, but, as this instrument may not be always available, the full, hard, bounding pulse must be relied on when found in association with corroborative symptoms.

Whatever leads to over-engorgement of either side of the heart may render bleeding necessary. If the left side of the heart be over-full arteriotomy is indicated; if the right, venesection. The object of the withdrawal of blood from the general circulation is the direct relief of the overburdened heart. Whether the right or left chambers be taxed, the immediate effect is the same; they are over-distended, and cannot exercise full power upon their contents. It is with the embarrassed heart as with other hollow muscular organs—the bladder and uterus. Over-distension paralyses them by removing the 'point d'appui' essential for the initiation of muscular contraction; the energy may be there, but it cannot be exercised. It is obvious that the amount of blood which it is necessary to withdraw, in order to free the embarrassed organ, must vary considerably in different cases; but it may be safely laid down as a rule that it need rarely exceed a few ounces. Excess in this respect is the evil which formerly existed.

On this subject we may refer to the eminently practical remarks of the late Sir Thomas Watson, who says: 'I hold it, then, to be certain, that for some special morbid conditions, which inflammation may or may not accompany, general blood-letting, and especially venesection, is a potent and life-preserving remedy; that there are many exigencies for which it is not only safe to employ, but unsafe and unpardonable to withhold it.'

He also gives the following judicious advice:—

'Always it is necessary to consider the age, the sex, the general temperament and condition of the sick person, when we are turning over in our minds the expediency of abstracting blood. The very young, the old, the feeble, the cachectic, do not bear well the loss of much blood. This consideration is not to deter you from bleeding such persons topically when they are attacked by dangerous inflammation, but it especially enforces, in regard to them, the golden rule that no more blood should be abstracted than seems absolutely requisite to control the disease.'

The following are some of the affections in which blood-letting would seem to be more or less indicated:—

Pneumonia.—Blood-letting in pneumonia, as in many other inflammations, is most useful in the early stages. It is indicated in healthy patients suffering from uncomplicated acute sthenic pneumonia, if they happen to be seen early enough. It relieves pain, abates fever, and if it does not arrest the disease, it certainly appears to lessen its duration. It may also be called for when there is severe pain and evidence of cardiac embarrassment. It did good, and will still do good, in cases of pneumonia attended by embarrassment of the circulation, and that in truth is the indication for bleeding in this disease.

Apoplexy.—The same may be said with reference to cerebral apoplexy. The old belief in the importance of 'letting blood' in cases of apoplexy was, if possible, stronger than in cases of pneumonia. But here again more accurate clinical and more extended pathological knowledge has taught us to look upon 'apoplexy' very differently to our forefathers. Recognising the escape of blood from the bursting of a brittle artery as a common cause of 'apoplectic fits,' we see the futility of venesection when the 'stroke' or 'fit' is due to a lesion of this kind. Nor will bleeding unstop an artery when it is plugged by an embolus, or carry nutriment to the region thus bereft of vital fluid. On the other hand we have learnt to recognise the value of bleeding in another class of cases of so-called 'apoplexy'—those which are unaccompanied by effusion of blood or lesion of the nervous tissue, but depend on rapidly occurring compression of the nervous centres from sudden or unequal increase in the volume of any portion of the cranial contents; or in certain cases of eclampsia from the circulation of blood poisoned by uneliminated urinary excreta. In cases of this description, when the right heart and venous system are engorged, phlebotomy acts beneficially: the stertor ceases, the purple face resumes its natural hue, the clouded intelligence becomes clear, and the impending danger is for the time averted. This has not cured the patient, however; it has only 'obviated the tendency to death:' it has saved the patient's life, though he may ultimately die of the disease which afflicts him. Where we meet with evidence of cerebral congestion, accompanied by fulness of the veins, a dusky countenance, and a *slow* full pulse, bleeding may most usefully be resorted to. In a word, although bleeding will not remove the effused blood in cases of cerebral hæmorrhage, it may sometimes be usefully employed to prevent further escape, when the heart is acting too forcibly; but it is altogether forbidden when that organ is enfeebled. The pulse at both wrists should be attentively examined before bleeding, in cases of cerebral hæmorrhage, for as a rule it is larger on the paralysed than on the sound side. *See* BRAIN, Hyperæmia of.

Eclampsia.—Indiscriminate bleeding in eclamptic seizures would be a grievous error. It would not relieve, but rather would probably intensify, convulsions of reflex origin, as in certain cases of puerperal convulsions. On the other hand, cases of puerperal convulsions accompanied by great turgescence of the vascular system, whether venous (as is commonly the case) or arterial, would be immensely benefited by the withdrawal of blood from the general current, either by venesection or by arteriotomy, according to the indication. This treatment may serve to stop the convulsions, and though that may be far from curing the disease, it may, nevertheless, be of the utmost value, for in the first place the fits themselves may kill by their violence or frequent repetition; whilst, secondly, time may be gained for the employment of other measures calculated to relieve the oppressed system, as, for example, purging by hydragogue cathartics, vapour baths, cupping the loins, &c. This gain may be immense; for bleeding may avert impending dissolution. Moreover, permanent good may ensue, inasmuch as bleeding reduces temperature, and in the eclampsia of pregnancy the temperature is usually high. In this it contrasts with pure uræmic convulsions, in which there is lowering of temperature.

Venous Engorgement.—Engorgement of the venous system arising from chronic disease, such as pulmonary emphysema or heart-disease, does not call for bleeding, unless the condition be acutely intensified by some intercurrent mischief, such as acute bronchitis; for, as the derangement is slowly produced, the organs and structures involved learn to accommodate themselves more or less to the altered conditions. It is only when vascular engorgement suddenly occurs in apparently healthy subjects, or, as just stated, there is acute intensification of a chronic condition, that bleeding is required. Thus, in cases where mediastinal tumours impede the return of blood from the head and upper portion of the body, the condition is ordinarily of such comparatively slow production, that bleeding is seldom urgently called for; and, moreover, it would be of but small service, for the obstruction is irremediable.

The lividity of the face which accompanies all fits should not be confounded with the duskiness due to engorgement of the venous system generally.

Uræmia.—In pure uræmia bleeding is useful; the kidneys being especially in default. For venesection answers a double purpose, by not only relieving the engorged right heart and venous system, but by removing from the body a certain amount of poisoned blood—blood that is charged with urinary excreta. Doubtless, it does good in both ways, but the former is, *quoad* the fits, the more important because more immediate mode of its action. The second effect, that of ridding the body of damaged blood, is obviously available for us when we have to deal with uræmia, occurring in the non-pregnant; and when coma is deepening, the heart labouring, and the vascular system turgid, no remedy is so swift and sure as the lancet.

Plethora.—Blood-letting may be called for in cases of general plethora, whether sthenic or asthenic. In the former condition the vascular system generally seems to be overfull, though the excess is most marked in the arterial system. Arteriotomy, however, is seldom called for, though it might at first sight seem indicated, since venesection usually answers every purpose.

In asthenic plethora, on the other hand, the venous system only is overfilled; the right side of the heart is distended and its action is laboured. Here venesection is sometimes called for, but it should be carefully employed. It is seldom necessary to withdraw more than from 6 to 10 ounces of blood, and often a smaller quantity will suffice.

Peritonitis.—The relief obtained by bleeding in acute peritonitis rendered venesection a famous remedy in this affection in former times. And there can be no doubt about its efficacy in relieving the pain of peritonitis, as of inflammation of other serous membranes. It may be used when the patient is young and strong, and in that stage of the disease which is accompanied by a small, hard, and wiry pulse—the pulse of a contracted artery, of augmented tension from contraction, not from overfulness. It is worse than useless in the later stages of the disease, when adynamia has set in. But valuable as bleeding may be in certain cases of peritonitis, it rarely happens that it is admissible, for in the great majority of cases inflammation of the peritoneum is secondary to other diseases, such as tuberculosis or disease of the kidneys. Where peritonitis arises after delivery it is commonly of septicæmic origin, and it is seldom indeed that bleeding is of any avail under such conditions. So that, practically, bleeding is not a remedy which we can often employ in peritonitis. A very high temperature cannot alone be held to be indicative of its use, for it so happens that such pyrexia is, as a rule, present only in septicæmic cases. Some cases of peritonitis, even fatal ones, run their course without any marked elevation of temperature: or indeed without showing any definite symptoms. Probably venesection is most serviceable in traumatic peritonitis, or it may be, when the inflammation is localised, though in that case leeches are more suitable.

Pleurisy.—When pleurisy attacks a young and robust patient, and is accompanied by severe pain, great relief follows blood-letting. The blood should be taken from a vein, and *pleno rivo*. But when, as so often happens, pleurisy is, like peritonitis, secondary to damaged blood-conditions — *e.g.* Bright's disease — bleeding is often inadmissible. When, as in pleuro-pneumonic cases, pleurisy complicates pneumonia, bleeding may possibly be called for, if there be great pain and oppression of the chest; but it should be most circumspectly used. Local blood-letting is much to be preferred if bleeding be thought necessary; for general bleeding is usually incompatible with the strength of the patient.

Uræmic Asthma.—In the affection known as uræmic asthma, in which there is spasm of the systemic arterioles, with intense turgidity of the arterial system and engorgement of the left heart, bleeding, in the form of arteriotomy, appears to be clearly indicated, though probably the use of nitrite of amyl or of nitroglycerine may render it less necessary.

Spasmodic Bronchial Asthma. — Pure asthma is doubtless often a nervous malady, and bleeding is not a remedy which should ordinarily be employed for its relief. It is only admissible when spasm of the pulmonary vessels, or obstruction to the flow of blood through them from bronchiole-spasm, leads to rapid engorgement of the right heart and venous system. This is the exact converse of uræmic asthma; but the effect in both is impediment to the aëration of the blood. Here the abstraction of a few ounces of blood from a vein may give immense and very prompt relief.

Emphysema.—Bleeding may be used in the so-called 'asthmatic attacks' to which emphysematous people are chronically prone. Here venesection may be imperatively demanded when an acute attack of bronchitis has, by adding to the already difficult passage of blood through the lungs, excited rapid engorgement of the dilated heart and previously turgid venous system.

Puerperal Diseases.—Formerly bleeding was much employed in midwifery practice, and especially in inflammatory affections after delivery. We now recognise that for the most part post-partum affections arise from septic mischief, and are of an adynamic type. It is but seldom that we are called upon to bleed in these cases. Nevertheless, now and again, venesection may be called for.

Disorders of Menstruation.—Bleeding is a most valuable remedy in certain menstrual disorders, and especially in the plethora of women at the change of life. Many women suffer distressingly from general vascular disturbance at this period. The flushings, headaches, giddiness, feeling of oppression, and other vaso-motor phenomena from which they suffer, in association with the cessation of the catamenial flow, are immensely relieved by an occasional venesection. No other measure will so quickly and so effectually relieve these symptoms. Some robust, plethoric young women with amenorrhœa require periodical bleeding. One of the writers has known the abstraction of a few ounces of blood speedily followed by the occurrence of the menses, in cases of what may be called congestive amenorrhœa of many months' or even years' duration. It may be well to state in this connexion that in certain pulmonary, intracranial, and other visceral lesions, danger may arise from the augmented arterial tension which for a few days precedes the flow, and that the abstraction of blood may avert hæmorrhage into the damaged organs.

After Operations.—Bleeding is less frequently called for in surgical than in medical practice. It is indicated mainly in the after-treatment of cases which present engorgement of the right heart and venous system, as in some cases of ovariotomy and other operations involving the abdominal or thoracic cavities. A turgid venous system, with a small hard pulse, and a labouring heart—a condition which is often associated with scantiness, amounting almost to suppression, of urine—indicates blood-letting after operations of the kind above referred to.

Shock.—In certain cases of shock the abstraction of a limited amount of blood may be required. This point will be found discussed elsewhere. *See* Shock.

Fever.—That bleeding will lower the temperature of fevered patients has been known from the earliest times. It is, however, not a remedy to be resorted to for that purpose alone, for, as the most pronounced hyperpyrexia occurs chiefly in association with conditions leading to great depression, blood-letting is under such circumstances as useless as it is dangerous.

Insolation.—There are few disorders in which blood-letting is more successful, when rightly employed, than in sunstroke. It is seldom necessary to take more than a few ounces of blood; and excess should be particularly guarded against, for fear of subsequent collapse. The insensible patient with turgid veins, a tight pulse, and a labouring heart, will gain immense and prompt relief from venesection. The extreme pulmonary congestion and over-distension of the right heart so often found *post mortem* might probably be prevented by the timely abstraction of a little blood from the venous system. Bleeding is not to be thought of in the syncopal form.

3. METHODS OF BLEEDING.—The following are the methods of performing the operations of arteriotomy and phlebotomy.

Arteriotomy.—This operation is best performed on the temporal artery. The vessel should be partially cut through by a simple transverse incision, and when a sufficient quantity of blood has been obtained it may then be completely severed, so that, retraction of both ends taking place, the hæmorrhage may be arrested. A compress of dry lint should then be applied, and a tight roller-bandage applied over it.

Venesection.—The median basilic vein is the one usually selected for the operation on account of its being most readily found. The brachial artery lies immediately beneath it, and care must be taken to avoid wounding the latter vessel. The median cephalic vein is preferable, but is not so easily found. A vein on the dorsum of the foot or other part of the body may be chosen, but, as a rule, it is not desirable to open the jugular vein, especially on account of the danger of the entrance of air, and other risks.

The steps in the operation on the arm are as follows:—First, the limb is to be firmly bound above the elbow by a broad tape or fillet. This should be applied with sufficient tightness to compress, and prevent the return of blood by, the veins, but not so as to intercept the current in the artery, and to extinguish the pulse. An oblique slit is then to be made in the vessel by means of a small lancet, care being taken not to cut too deeply. The spirting blood should be caught in a vessel and measured.

When sufficient blood has been withdrawn, the operator should firmly place a thumb or a finger on the aperture, and then, on removing compression, place upon the wound a dossil of dry lint, antiseptic dressing, styptic-colloid, or such-like, over which a roller-bandage should be twined a few times like a figure of 8, the cross being over the wound.

Local Bleeding.—The object of local bleeding is the relief of congested vessels, and especially those of inflamed parts. Arteries convey more blood to, and veins convey more away from, inflamed parts; so that local bleeding may give great relief and initiate resolution, since absorption does not fully commence until inflammation has ceased.

METHODS OF LOCAL BLEEDING. — Blood may be abstracted topically by leeches, by scarifications, or by wet-cupping.

1. *Leeching.*—An average leech will abstract nearly half an ounce of blood. Leeches are extremely useful in a great variety of affections, since a pretty definite amount of blood can be withdrawn from the affected or adjacent parts, or from more distant parts, through intimacy of the vascular connexion, as in diseases of the eye and ear, and in hepatic diseases, accompanied by obstruction to the flow of blood through the portal system, when the application of leeches to the anus is most valuable.

Care should be taken not to apply leeches to parts over which sufficient compression cannot be made so as to control the bleeding, should any difficulty arise in arresting it otherwise. Thus, leeches should not be applied over the trachea, especially in children, in whom the error of applying them over the episternal notch is sometimes made. For the same reason the fontanelles should be avoided.

The skin of the part where the leeches are to be applied should first be washed; and when they do not bite readily, the part may be wetted with a little milk or sugar and milk. A slight prick of a needle, sufficient to draw a speck of blood, will often cause them to bite when refractory.

Should the bleeding continue too long after the leeches fall off, pressure or styptics may be applied. If it is desired to encourage bleeding, fomentations of hot water or linseed poultices are serviceable.

In applying leeches to the cervix uteri, the precaution of closing the os by a plug of wool should not be neglected. When they are applied within the mouth, a leech-glass should be used.

2. *Scarifying.*—Scarifications consist in small cuts of a depth not exceeding the eighth of an inch, or less, into the tissue whence it is desired to take blood. This mode of topical bleeding is mainly applied to the cervix uteri, to the tongue in acute glossitis, and to the palpebral conjunctiva in certain kinds of conjunctivitis; in the last case only slight incisions are permissible. Deeper punctures are made by some practitioners into the tissue of the cervix uteri, but these are punctures and not mere scarifications.

3. *Wet-Cupping.*—Cupping and the use of the scarificator, constituting wet-cupping, is an important method of topical blood-abstraction; and as a considerable amount of blood can thus be withdrawn, the general circulation may be affected. It is ordinarily employed, however, for its local effects.

The method of its performance is as follows:—Cupping-glasses being first put on for a brief time, as for dry-cupping (*see* CUPPING —*Dry-Cupping*), the operator applies to the part selected a spring scarificator so adjusted as to cut only to the required depth—about an eighth of an inch or less. The cupping-glasses are then re-applied, and the desired number of ounces of blood abstracted. If the glasses be too tightly attached the blood will not flow readily, and unnecessary pain may be caused. After their removal adhesive plaster, or dry lint and a bandage, should be applied to the part.

Cupping is extremely useful over the loins in renal ischæmia; on the temple or behind the ears in certain cerebral disorders; down the spinal column in inflammation of the spinal cord or meninges; and on the chest in certain pulmonary and cardiac affections.

Alfred Wiltshire. Richard Quain.

BLOOD-DISEASE.—The term *blood-disease* was used by the humoral pathologists as synonymous with *dyscrasis* or *anomalous crasis of the blood*, and expressed the idea that the blood was the seat 'almost without exception' of all general diseases. And, further, since purely local disease was considered to be exceptional, the vast majority of diseases were referred to dyscrases, and were classed under the head of blood-diseases.

The condition of the blood was considered by the humoralists to depend upon the *crasis*, that is the mixture, of its constituents; and prominent among its constituents were reckoned the *blastemata*, or germinal substances of the different tissues, which exuded through the capillary walls in the process of nutrition. When the blood-crasis was disordered or diseased, a dyscrasis was said to exist; and dyscrases were held to be in the majority of cases primary, though it was allowed that local anomalies of nutrition might and did occasionally occur, and give rise to secondary dyscrases. A blood-disease or dyscrasis being established, all morbid changes throughout the body were believed to be but local manifestations of the same. For the purpose, therefore, of a rational classification of disease, a previous classification had to be made of the dyscrases. The principal blood-crases were said to be:—

1. The *fibrin*-crasis; including the *simple* fibrin-crasis, the *croupous* crasis, and the *tubercle*-crasis as varieties. The local expression of the fibrin crases was inflammation in some form.
2. The *venous* crasis, in which fibrin was deficient. This included a vast number of special crases, lying at the foundation of the most diverse diseases—*e.g.* plethora, heart-disease, the acute exanthemata, rickets, albuminous urine, cholera, acute tuberculosis, lardaceous disease, cancer, acute convulsive diseases, metallic poisoning, &c.
3. The *serous* crasis; associated with anæmia.
4. The *putrid* or *septic* crasis.
5. *Anomalous* crases; such as those of syphilis, gout, &c.

The theory of dyscrases may be said to have declined since the appearance of Virchow's *Cellular Pathology*. Virchow showed that the blood is, in every relation, not an independent but a dependent fluid, and that the sources from which it is sustained and restored, and the exciting causes of the changes that it may suffer, lie without it, not within it. Substances may enter the blood and affect the corpuscles injuriously; the blood may act as a medium in conveying to the organs noxious substances that have reached it from various sources; or its elements may be imperfectly restored. But never is any 'dyscrasis' permanent, unless new influences arise and act upon the blood through some channel or through some organ.

At the present time, whilst it cannot be said that humoralism is professed by many pathologists, the notion of blood-disease, as generally entertained forty years ago, still clings to our nomenclature, and pervades some of our pathological doctrines. Diseases that affect the whole economy—syphilis, tuberculosis, gout, and cancer—are frequently described as 'constitutional,' or 'blood-diseases,' and this whether their general manifestations are secondary to local disease, as in syphilis and cancer, or are referable to inheritance. While the *morbid conditions* of the blood are real and numerous, 'blood diseases,' so called, are but abstractions, and, as such, a fruitful source of confusion and useless discussion. It is desirable that the term *blood-disease* should be abandoned, and that the expression *morbid conditions of the blood* should be applied to those pathological states of the vital fluid which can be distinctly demonstrated by physical, chemical, or histological examination.

J. Mitchell Bruce.

BLOOD, Morbid Conditions of.—The characters, composition, and functions of the blood in health are sufficiently familiar, and are fully described in text-books. But certain facts connected with the physiology of this fluid have a special bearing upon its pathology, and must be briefly considered before its morbid states can be profitably discussed.

A. Physiology of the Blood.—The *red corpuscles* of the blood consist of two portions—a colourless, sponge-like matrix; and a coloured substance of complex composition, which occupies the interstices of the former and accurately fills them. The matrix is regarded as possessing chiefly physical properties; whilst its contents constitute the active part of the corpuscle, and consist of hæmoglobin. The source of the red corpuscles is of the greatest pathological importance. In the embryo the blood and blood-vessels are developed from the same elements, and thus the two structures in their physiological aspect are essentially inseparable. In fully-developed blood the source of the red corpuscle is obscure; but there can be no reasonable doubt that it originates in the spleen and the medulla of bones; and that light is of the greatest importance in the formation of hæmoglobin. With respect to the properties and function of the red corpuscle, it is to be noted that the ultimate elements of hæmoglobin are carbon, nitrogen, hydrogen, oxygen, sulphur, and iron—the last closely associated with the colouring matter. Hæmoglobin is soluble in water, forming a lake-coloured liquid from which fine crystals may be obtained, and which may be variously decomposed, giving rise to other 'blood crystals.' Most important of all its properties, hæmoglobin combines with certain gases to form definite chemical compounds: with O to form oxyhæmoglobin; with CO to form carbonic-oxide-hæmoglobin; and with NO to form nitric-oxide-hæmoglobin. These compounds are more or less unstable, especially the oxyhæmoglobin, which is broken up even under very feeble influences to oxygen and reduced hæmoglobin. Alternate oxygenation of hæmoglobin and deoxygenation of oxyhæmoglobin are constantly going on within the red corpuscles of the circulating blood; and the two changes, occurring in the pulmonary and systemic capillaries respectively, constitute the first great function of the blood—its oxygenating or respiratory function. The volume of oxygen in arterial blood is 20 per cent.; in venous blood 8 to 12 per cent. It must be clearly understood that disorders connected with the red corpuscles or respiratory elements of the body, whether in amount, composition, or circulation, directly affect the oxidation-processes only. Besides its origin and its function, there is a third relation of the red corpuscle to the organism—namely, the disposal of its products. These are eliminated by the ordinary channels; the salts, which are chiefly salts of potassium, being excreted by the kidneys, and the coloured material furnishing the pigments of the bile and urine.

The *white* or *colourless corpuscles* of the blood, also called leucocytes, are chiefly derived from the corpuscles of the lymph, and the cells of the lymphatic glands and allied organs, which they closely resemble. By escaping through the walls of the blood-vessels, they become identical with the wandering-cells of tissues and with pus-corpuscles,—from which they are indistinguishable except by locality. Some authorities regard them as *phagocytes*, attacking, and if possible destroying, pathological organisms in the blood and tissues. They may also influence the plasma by continually ingesting and egesting certain of its constituents. It might, therefore, be expected that morbid states of the leucocytes would be associated with disorders of the lymphatic structures, connective tissues, blood-plasma, and blood-vessels; and this will presently be shown to be the case. The proportion of white corpuscles in the blood is subject to physiological increase, without becoming excessive—*e.g.* after meals, during periods of growth and development, and in menstruation and pregnancy. This state is called *physiological leucocytosis* (Virchow), and signifies lymph-glandular excitement. The chemical products of the leucocytes contain a large proportion of potassium and phosphoric acid.

The *blood-plates*, *-platelets*, or *-tablets* (*hématoblastes* of Hayem), minute bodies to be seen in blood, both within the vessels and after it has been drawn, are of obscure nature, origin, and function. Possibly they play some part in coagulation.

Plasma.—The physiological relations of the plasma to the organism are extremely complex; and disturbance of these relations furnishes many of the symptoms of disorder of the blood. Its mature function is essentially one of nutrition: it supplies the tissues with oxidisable material for development, growth, support, secretion, and the liberation of force. The source of the plasma is equally extensive. It derives its principal constituents from the alimentary canal through the absorbent glands and liver; while other important albuminous substances are being constantly supplied from the tissues generally, through the lymphatic system. Lastly, the products of the plasma, such as carbonic acid, urea, and water, are discharged by the regular excretory channels. Thus the condition of the plasma is found to be most intimately associated with that of the organs and tissues generally, whether as regards its origin, its mature function, or its products; and it is affected by disorder or disease of every organ, whether alimentary, sanguifacient, dynamic, or excretory, and of every tissue.

Coagulation of the Blood: Fibrin.—Under certain circumstances, especially after removal from the body, the blood coagulates, and a proteid substance, fibrin, separates more or less completely from the other constituents. This change is now believed to be due to the interaction of two fibrin-factors contained in the plasma, namely, a ferment—fibrin-ferment, and fibrinogen; and along with these there must be present some neutral salt. The amount of fibrin produced varies not only with the amount of these bodies, but with the amount of salts, with the degree of alkalinity and of heat, and with other influences; and these variations are subject to no law at present known. The rapidity of the process depends upon (1) the amount of ferment; (2) its increased activity by moderate elevation of temperature; and (3) agitation of the blood and the increased number of points of contact (so-called 'catalytic' action)—by the presence of red corpuscles, hæmoglobin, charcoal, &c. It thus appears that the expressions 'amount of fibrin' and 'rapidity of coagulation,' however important as facts, do not afford any definite indication of the state of the blood, as was formerly believed. Three essential factors, and a large number of accidental influences, share in the process; they may do so in very various proportions and degrees; they do not vary together; the amount of fibrin is not in proportion to any one of them; and after coagulation is complete, portions of all the factors probably remain uncombined. The part played by the red corpuscles in coagulation is a double one —(1) the corpuscles, 'as points of contact,' greatly increase the rapidity of coagulation; and (2) they supply oxygen, which appears to be indispensable to the process. The leucocytes probably produce the ferment; but it is doubtful whether it exists in the intact blood-cells. The blood-plates may also share in the process.

B. Pathology of the Blood.—The morbid states of the blood will now be considered in the following order:—1. Changes in quantity, and the effects of such changes upon the composition of the vital fluid. 2. Morbid conditions of the red corpuscles. 3. Changes in colour. 4. Melanæmia. 5. Morbid states of the white corpuscles. 6. The pathology of the blood-plasma; and of the process of coagulation. 7. The presence of foreign materials in the blood, including poisons and infective substances. 8. Organisms.

1. Changes in Quantity of the Blood. Alterations in the total amount of blood in the body are perhaps never simple, but always associated with alterations in quality.

(*a*) *Polyæmia*, or *excess* of blood in the body generally, may be the result of excessive ingestion of the elements of blood; of the accumulation of the same by the suppression of habitual hæmorrhages or fluxes; of the loss or obsoleteness of a part of the body, such as a limb or a lung; or of insufficient exercise. It cannot be said, however, that polyæmia has ever been demonstrated by exact investigation, inasmuch as the total amount of blood in the body is still uncertain, and the physiological limits in this respect are very wide. Polyæmia is believed to be present in *plethora*, along with relative excess of the solids, particularly the red corpuscles.

(*b*) *Oligæmia*, or *deficiency* of the total amount of blood, is, on the contrary, an exceedingly frequent change, and constitutes the simplest form of anæmia. It is, however, probably never pure, inasmuch as alterations in quality appear to be inseparably associated with it; and the terms *hydræmia* and *spanæmia* have accordingly been used as synonymous with the preceding. The manner in which diminution in quantity gives rise to alteration in quality must be considered here.

When hæmorrhage occurs to any amount, and the whole quantity of blood in the vessels is reduced, the pressure falls, and absorption of the parenchymatous plasma rapidly follows, by which, along with vasomotor stimulation, the physical relations are restored. If the loss of blood has been moderate, the only change in its composition may be considered to be *oligocythæmia*, or diminution of the red corpuscles, which alone of all the constituents of the blood cannot be rapidly restored. If the hæmorrhage has been more serious, the fluid absorbed into the circulation from the tissues, from the suppressed secretions, and from the alimentary canal, consists of water in ever-increasing excess, which carries with it an amount of salts equal to one-ninth the loss in albuminous substances. The morbid state of the blood is now beyond oligocythæmia; there is deficiency of albuminous constituents, or *hypalbuminosis*, and the condition correctly called *oligæmia vera* or *anæmia* is the result. The total quantity of blood probably remains for some time below the normal. A similar impairment of the quantity, and therewith of the quality of the blood, may be slowly developed by repeated small hæmorrhages, or by any cause whatever that impoverishes the blood, whether of the nature of waste or of want. The condition which results closely resembles that just described in the acute form—oligæmia with oligocythæmia and hypalbuminosis; the same is also known clinically as anæmia. *See* Anæmia.

As a therapeutic measure, oligæmia may be desirable. It may be induced either (1) by direct abstraction of blood, or (2) by gradual impoverishment of the blood, and reduction of the intra-vascular pressure. *See* Blood, Abstraction of; and Aortic Aneurysm; *Treatment*.

2. Morbid Conditions of the Red Corpuscles.—The pathology of the red corpuscles is still imperfectly understood. The following comprise the most important changes connected with them so far as they are known.

(*a*) *Polycythæmia: plethora polycythæmica.*—Increase in number of the red corpuscles is never considerable, being generally transitory and within physiological limits—for example, in the newly-born, and after meals. It has already been mentioned as associated with polyæmia in plethora. In the algid stage of cholera the red corpuscles are relatively in excess.

(*b*) *Oligocythæmia.*—Diminution in number of the red corpuscles is, on the other hand, of very frequent occurrence and great pathological importance. Microscopically the number of red corpuscles in a given visible area of blood is diminished; and chemically the amount of hæmoglobin in a given volume of blood may fall from fifteen even as low as five per cent. (*see* Hæmacytometer). The principal circumstances under which oligocythæmia occurs are—(1) in anæmia, or diminution in the amount of blood as a whole, from any cause, whether rapid or protracted, especially as the result of fever, the red corpuscles suffering early, seriously, and persistently, as compared with the other constituents; (2) in leukæmia—the development of the red corpuscles being interrupted; (3) in hypalbuminosis, where the red corpuscles, like other elements, suffer from want of albuminous material; (4) in chlorosis, from imperfect growth; and (5) in pernicious anæmia, from excessive destruction (hæmolysis).

(*c*) *Oligochromæmia.*—Deficiency of the red corpuscles in hæmoglobin has been described by this name. It is a morbid condition of much interest, inasmuch as it is one of the essential alterations of the blood in chlorosis. When the individual red corpuscle contains less hæmoglobin than normal, it is said to present a pale appearance to the eye. A more trustworthy method of determining the richness of the red corpuscles in hæmoglobin, is by means of the hæmoglobinometer (*see* HÆMOGLOBINOMETER). Or we may compare the amount of hæmoglobin in a given weight of blood with the number of red corpuscles in a given microscopical area. When the former is small in proportion to the latter, the defect must lie in the individual corpuscle; and this may be so great that the proportion of hæmoglobin falls, as in some cases of chlorosis, to twenty-five per cent. of the normal. *See* CHLOROSIS.

(*d*) *Aglobulism.*—The effects of the two conditions of blood just described, namely, oligocythæmia and oligochromæmia, may be discussed together under the head of aglobulism, or deficiency of the blood in hæmoglobin. Want of this, the oxygenating substance of the organism, gives rise to symptoms at once extremely various amongst themselves, and of serious import. Every vital process, whether developmental, plastic, secretory, dynamic, or nutritive, is absolutely dependent on a free and immediate supply of oxygen. All of these processes, therefore, will suffer in aglobulism. The respiratory and circulatory movements are accelerated. The complex processes of alimentation and secretion are performed imperfectly, and the results are dyspepsia, constipation, and disordered sanguification—which intensify the abnormal blood-state. Muscular contraction is feeble, and cannot be sustained. Psychical force is weak; and dulness, sleepiness, pains, and other symptoms indicate imperfect oxidation within the nervous system. Bodily growth and development—of the sexual organs, for example—remain incomplete, and puberty is deferred. Nutrition everywhere suffers, the materials being insufficiently oxidised; and substances 'intermediate' to albumin on the one hand, and carbonic acid, water, and urea on the other hand, are formed, especially oils. Thus the organs and the connective tissues become loaded with fat and enlarged, instead of suffering atrophy, as they do when the blood-plasma is deficient. Finally the excretions are disturbed, and the subject of aglobulism presents derangement of the colouring matters of the bile and urine, which are derived from hæmoglobin. *See* ANÆMIA, PERNICIOUS.

Histological changes.—Alterations in the *size*, *outline*, and *consistence* of the red corpuscle have been frequently recorded, but such accounts are incomplete, and no entirely successful attempt has yet been made to connect any of these changes with morbid processes in the tissues. In severe fevers, such as typhus, and in some rapid malignant diseases, the red corpuscles appear peculiarly soft, their outline being less resistant and sharp, and the bodies running together into irregular heaps, instead of into *rouleaux* with well-defined lines of contact between the elements. In another class of cases the corpuscles appear small and crenated or like the 'thorn-apple.' *Macrocythæmia* and *microcythæmia* have also been described as temporary and variable conditions, in which the red corpuscles are abnormally large and abnormally small respectively. These changes, as well as alterations in form, the corpuscles being oval, tailed, pear-shaped, or irregular (*poikilocytes*), or provided with excess of hæmoglobin, occur in pernicious anæmia (*see* fig. 3, page 61). *Transitional cells* between the white and the red corpuscle are unusually numerous in some cases of leukæmia.

3. **Changes in colour.**—The colour of the blood is chiefly due to the red corpuscles, and alterations from the normal in this direction will be best considered in this place, although the white corpuscles and the plasma may also affect the colour, as will be presently shown.

(*a*) The chief determining cause of the colour of the blood is the chemical condition of the hæmoglobin. When this is united with oxygen, in the arteries, the blood is *scarlet*; as deoxidation advances, this colour passes into a *purple*, and finally becomes *black* or venous. The dark colour is directly due to absence of oxygen. The purest example of this change is seen in asphyxia, where oxygen is excluded from the blood; but it also occurs as the result of the action of certain injurious influences upon the corpuscle itself, such as extreme heat, or poisoning by phosphorus, prussic acid, and other toxic agents. If the change proceed no farther, the scarlet colour may still be restored by oxidation. This blackness of the blood is generally associated with imperfect coagulation or even a state of fluidity. *See* Fibrin, page 164.

(*b*) *Paleness* of the blood is observed in oligæmia and oligocythæmia, and is due to deficiency of the hæmoglobin.

(*c*) The blood may not only be pale, but present streaks somewhat resembling pus, even as it flows from the living vessels, as in leukæmia. The same blood will settle on standing into three layers—of plasma superiorly, loosely coagulated or not; of white corpuscles in the middle—a puriform layer; and of red corpuscles at the bottom.

(*d*) The *milky* appearance of chylous blood will be presently described under the head of *Blood-Plasma.*

(*e*) *Lake-coloured blood.*—A remarkable change of the blood, in which it becomes lake-coloured or transparent, is frequently observed as a more advanced stage of that just described under (*a*); but it may occur under other circumstances than deoxidation, and is of grave significance, inasmuch as it indicates complete and hopeless destruction of the red corpuscles. Lake-coloured blood is no longer opaque, but transparent; the hæmoglobin has left the corpuscles and is dissolved in the plasma. The change can be effected experimentally by the addition to blood of water, chloroform, the bile-acids, or other solvents; and it is probable that some of the cases of rapid death after enormous draughts of water, and the destruction of red corpuscles which is believed to occur in jaundice, may be accounted for in this way. But the most important cause of 'solution' of the red corpuscles is complete deoxidation of the hæmoglobin, which is followed by its diffusion in the plasma. Thus drawn blood is rendered lake-coloured by the addition of sulphide of ammonium, phosphorus, phosphoric acid, or iron-filings; and the same effect is produced by the intravenous injection of salts of the bile-acids. This being so, it might be expected that blood would assume the lake appearance when exposed to the prolonged action of the causes that render it black; and recent observations seem to indicate that such is the case. In a number of diseases which are attended with an accumulation of oxidisable substances in the circulation, the blood has been described as 'fluid,' 'claret'-or 'cherry-coloured,' 'clear,' and 'staining the tissues,'—but apparently without more exact observations on the colour of the living plasma. Such morbid states are high fevers (hyperpyrexia), insolation, and poisoning by malaria, phosphorus, and perhaps other agents. The effect of some of these influences is obviously to produce an excessive amount of oxidisable material in the blood, while the others may lead to the same result by reducing the oxygenating capacity of the corpuscles. Persons dying under such circumstances present great lividity, from the black or venous condition of their blood; death occurs with symptoms indicative of want of oxygen, as if so much of the hæmoglobin had been diffused through the plasma; and *post mortem* the vessels are found stained with the solution, the tissues are soaked with fluid lake-coloured blood, and decomposition is early and rapid. The 'fluidity' of such blood, or absence of clot in it, will be presently accounted for under *Fibrin.* That a similar solution or destruction of the red corpuscle may occur in all cases of fever, only in a much less degree, is supported by several facts: (1) the increased discharge of potassium-salts in fever; (2) a similar increase of the colouring matter of the urine; and (3) the anæmia that is found at the termination of the process.

(*f*) Other alterations in colour may occur in the blood. The blood is *cherry-red* after poisoning by carbonic oxide, and remains so after exposure. It is *chocolate-coloured* after poisoning by the nitrites, such as nitrite of amyl, giving the spectrum of methæmoglobin —a more stable compound than hæmoglobin; and other hues have been recorded.

4. **Melanæmia.**—In relation with the pigment-bearing element of the blood there may be mentioned a morbid condition which has been described under the name of melanæmia. In this disease the blood presents black and brown pigment-particles and flakes, free or contained in cells of various shapes. These bodies arise from the disintegration of the red corpuscles; and are partly absorbed by the leucocytes, partly deposited in the spleen, liver, brain, and bone-marrow. Melanæmia is especially associated with two other states, namely, malaria, and an enlarged deeply-pigmented condition of the spleen; and one view of its origin is that the red corpuscles are destroyed in the spleen by the fever, and that the pigment-particles thus produced find their way from the spleen into the blood. They are then deposited in the liver and other organs, and give rise to symptoms of visceral disturbance during life, and to the peculiar slaty or grey discolouration that is found *post mortem.* It has been said that in melanotic cancer pigmented cells have been found in the living blood.

5. **Morbid Conditions of the White Corpuscles.**—The white corpuscles of the blood may undergo certain morbid changes both in number and appearance.

(*a*) The most remarkable of these is *increase* in number, which may rise from the normal (1 to 350 red) until the white corpuscles become even the more numerous. This condition is known as *leucocythæmia* or *leukæmia* (*see* Leukæmia). Short of this, however, the proportion of white corpuscles in the blood may be appreciably increased, and to this minor condition the name of *leucocytosis* has been applied. Leucocytosis, according to Virchow, accompanies, almost unexceptionally, every case of lymphatic excitement, such as inflammation, and tubercular, scrofulous, or cancerous enlargement or swelling of the glands and allied structures—Peyer's glands, the solitary follicles, the spleen, and the tonsils. Leucocytosis is distinguished from leukæmia by its very moderate degree; by its evanescent course; by the absence of deficiency of the red corpuscles; and by the accompanying symptoms. Leucocytosis may be appreciated even by the naked eye in the clot of drawn blood, by the presence of an irregular 'lymphatic layer'—*crusta lymphatica*, consisting of collections of white corpuscles between the red clot and the buffy coat, which so frequently occurs along with it.

(*b*) A *diminution* in the number of white corpuscles occurs in chlorosis; and, it is said, in malaria, especially during the paroxysm of fever.

(*c*) With regard to the *structure* of the individual white corpuscles, the proportion of uninuclear or young cells, and the multinuclear or aged cells, may be disturbed both in leucocytosis and leukæmia; while corpuscles may be found containing granules of various kinds, especially pigment-particles, bacteria, micrococci, and other structures.

6. Morbid Conditions of the Blood-plasma.—(1) Water.—The limits of the physiological variations in the amount of water in the blood are very wide.

(*a*) *Diminution* of water in the blood is observed in various degrees. It is moderate and transitory as the result of stimulation of the kidneys, skin, or bowels, for the normal proportion is speedily restored by absorption. This condition is also found after severe purgation, sweating, diarrhœa, or dysentery; and its production is the rationale of several of the methods adopted for the relief of dropsy. If the drain of water continue, or if the supply fail, the anhydric condition of blood increases, so that the fluid appears black, thick, and tarry. Such is the state of the blood in the algid stage of cholera; the specific gravity of the blood rising from 1055° as high as 1080°, with a comparative excess of salts, albumen, and urea. The chief symptoms of great deficiency of water in the blood are intense thirst; a shrivelled, shrunken aspect of the body generally; coldness and lividity of the extremities; muscular pains; and suppression of the excretions—phenomena directly referable to loss of water, retardation of the circulation, and interference with the function of the red corpuscles.

(*b*) *Excess.*—*Hydræmia.*—Reference has been already made under the head of oligæmia to the anæmia or hydræmia that follows it. Excess of water in the blood (*plethora serosa s. aquosa*) is perhaps never absolute, and the change may therefore be regarded with equal accuracy and greater convenience as deficiency of solids.

(2) Albuminous Constituents.—On reviewing what has already been said under the head of Coagulation and Fibrin, the reader will observe that 'amount of fibrin,' and other expressions connected with the albuminous constituents, must be regarded at present as comparatively meaningless, in the light of our knowledge of the process of coagulation. Inasmuch, therefore, as little value can now be attached to the analyses of fibrin that have been made in different diseases, it follows that the estimates of the albuminous substances left after coagulation—that is, of the albumins of the *serum*, must also be rejected. But the total amount of albumins in the blood may be easily ascertained; and this is subject to extensive variations. The balance between the albuminous substances which enter the blood from the alimentary tract and the lymphatic system, on the one hand, and the products of their transformation by the tissues, on the other hand, is represented by the albumins of the blood. These will increase accordingly when the supply is excessive, or the consumption small; and will decrease under the reverse circumstances.

(*a*) *Plethora hyperalbuminosa* is the name given to *excess* of albumins in the plasma. The amount has been found notably increased when the activity of the tissues is abnormally heightened, as, for example, in inflammatory diseases (acute rheumatism, tonsillitis, pneumonia, and pleurisy), and fibrinogen, which is the product of this increased activity, is poured abundantly into the blood. The amount of albuminous fluid produced in an inflamed part, whether it appear as a catarrh, an infiltration, an exudation, or an effusion, is very great, and may be enormous; and, under favourable circumstances, this and much that cannot be so easily appreciated are carried into the blood, the lymphatic structures swelling *en route*. Albuminous plethora, as a result of diminished oxidation, probably does not exist; for the effect of an insufficient supply of oxygen to the albumins (from want of exercise or over-feeding) is not the accumulation of these in the blood, but the formation of 'lower' products, such as uric acid and its allies, and the deposit of fat. Relative hyperalbuminosis is a necessary but transient effect of cholera and other severe watery fluxes.

(*b*) *Oligæmia hypalbuminosa*, or *deficiency* of albumins in the blood, occurs under exactly opposite circumstances from the preceding,—whether the ingestion of albumins from the alimentary tract and the tissues be comparatively small, or the consumption excessive. Inanition, therefore, on the one hand, and its multitude of causes, are associated with such poverty of blood; and so, on the other hand, are loss of blood, profuse discharges of albuminous fluids, morbid growths, and other sources of waste, as well as excessive demands of growth and development. The albumins of the plasma may fall under these circumstances from 80 to 37 parts in 1,000. Such hypalbuminosis is, however, never simple: the blood cannot be deficient in albuminous substances and otherwise normal, for, as we have already shown, loss of albumen is always followed by absorption of water and salts from the tissues in definite proportions, and anæmia is the result. The red corpuscles suffer at the same time, for their nutrition speedily fails in hypalbuminosis, and aglobulism ensues. Hypalbuminosis is a serious disorder of the blood. The relations of these conditions to each other and to oligæmia are even more complicated clinically than they are pathologically; and in this relation the whole of them are most conveniently discussed under the comprehensive head of anæmia. *See* ANÆMIA.

(3) CLOT; FIBRIN.—However uncertain as a measure of any particular constituent in the blood, the amount of clot or fibrin demands a brief notice as a matter of fact.

(*a*) *Abundant* clot has been considered as indicating an excess of fibrin in the blood or *hyperinosis*, the proportion being stated to rise as high as 1·0 instead of 0·2 per cent. Acute rheumatism, erysipelas, croupous pneumonia, and pleurisy are the diseases in which hyperinosis is most marked; but it also occurs in pregnancy. The two principal conditions of its occurrence appear to be—(1) increased activity of the tissues, including inflammation; and (2) free and abundant communication of these tissues with the blood through the lymphatic system.

(*b*) *Deficiency, looseness,* or *absence of clot; 'Fluid blood.'*—A small loose clot is frequently observed, as for example in typhoid states, or in chronic wasting diseases attended with loss of blood; and has been described as indicating *hypinosis* or deficiency of fibrin. When the condition is extreme, the clot may be absolutely wanting, as in certain cases of anæmia. The blood then separates on standing into three layers—an upper, consisting of clear liquid; a middle, puriform, of white corpuscles; and a lower, red, of red corpuscles. In another and larger group of cases, non-coagulating or fluid blood is at the same time of an intensely dark or even lake colour, and is commonly described as 'black.' The circumstances under which this condition of blood occurs, and the cause of the remarkable colour, have been already noticed; and it remains to account only for the fluidity. The profound alteration of the red corpuscles, the want of oxygen, the interference with the production of the ferment, and the changes in the fibrinogen—one and all combine to prevent coagulation.

(*c*) *Buffy coat.*—Another phenomenon connected with coagulation, from which erroneous and even dangerous conclusions have been drawn, is the so-called *buffy coat*. The process of coagulation is generally sufficiently slow to allow of the gravitation of some of the red corpuscles from the surface of the blood; and the corresponding part of the clot is accordingly paler. When the pale layer is unusually large it is known as the buffy coat or *crusta phlogistica*: it may be seen in the blood in pregnancy, inflammatory fevers, hydræmia, and oligocythæmia. When these cases are analysed, it is found that the conditions favourable to the formation of the buffy coat are probably all more or less connected with the red corpuscles, namely—(1) increased specific gravity of the red corpuscles, as in oligocythæmia and hydræmia—allowing more rapid sinking; (2) interference with the catalytic action of the hæmoglobin, which is so powerful in determining the rapidity of coagulation, as in fevers and oligocythæmia; and (3) want of oxygen, corresponding to the amount and condition of the hæmoglobin, as in the same diseases. One and all of these states render the process of coagulation slow compared with the descent of the red corpuscles; and the buffy coat is the result. It thus appears that the buffy coat is no indication whatever of excess of fibrin-generators, or of the opposite; and that it is found under the most diverse conditions of blood.

(4) SALTS.—The amount of positive knowledge concerning morbid alterations of the salts of the blood is but small. It is to be observed that the salts of the plasma have chiefly sodium for their base in the form of chlorides, whilst potassium salts and phosphates mostly reside in the corpuscles.

(*a*) *Diminution.*—In febrile diseases there is an increased discharge of compounds of both bases, but at different periods; the potassium salts appearing in excess in the excretions until the crisis is past, and the sodium salts during defervescence. At both periods, it may be considered certain that the blood is the chief source of the salts excreted; and that it is accordingly deficient in these constituents.

(*b*) *Excess.*—On the other hand, the salts of the plasma are relatively in excess in hypalbuminosis, replacing, in the proportion already stated, the lost albumins. The effect on the salts of the blood of such drains as occur in cholera has been variously stated; some authorities declaring that it is an increase, others a diminution.

(*c*) *Reaction.*—The alkalinity of the blood is said to be diminished in gout, cholera, and osteomalacia.

(5) FATS.—The normal increase of fats in the plasma that occurs after meals may be exaggerated by a diet rich in oil, and, it is said, in the subjects of diabetes, in chronic drunkards, and in persons disposed to obesity—*lipæmia*. When this increase is so great that the serum presents a milky appearance the blood has been called *chylous*. A cream-like scum forms on the surface of the serum; and the milky appearance is found microscopically to be due to the presence of fine granules and oil-globules. A marked increase of fatty matters in the blood has been said to occur in some cases of chyluria. Fat may also appear in the blood as a foreign body, by the escape of marrow into the circulation in fracture of bones—and that

in such quantity as to cause fatal capillary embolism. *See* EMBOLISM.

(6) CARBONIC ACID GAS, which exists in arterial blood in the proportion of 39 per cent., and in venous blood of 52 to 58 per cent., by volume, may accumulate within the circulation either by increased formation or by retention. Although associated with asphyxia, this increase of carbonic acid gas is probably not the chief cause either of the symptoms of that condition, or of the dark colour of the blood that accompanies it. *See* ASPHYXIA.

(7) OTHER CONSTITUENTS.—Amongst the most important of the other constituents of the blood, the following are to be noticed:—

(*a*) *Urea*, which exists in normal blood to the amount of 1·8 parts in 10,000, may increase in uræmia by two or three times. There is still much uncertainty, however, on this subject (*see* URÆMIA). Disease of the urinary organs, which interferes with the elimination of urea and allied products from the blood, is the usual cause of uræmia; but excessive tissue-change, as in fever and inordinate muscular exercise, has also the same effect.

(*b*) *Uric acid*, found in normal blood in minute traces, is increased (as quadrurate of soda) in all cases of gout, and may amount, according to Sir Alfred Garrod, even to 0·175 parts in 10,000. Its presence is easily demonstrated by the thread-experiment (*see* GOUT). Uric acid is also increased in leukæmia and chlorosis—perhaps from the imperfect oxidation associated with the condition of the red corpuscles.

(*c*) *Leucin*, *tyrosin*, *hippuric acid*, *sarcin*, and other allied complex compounds, have been frequently found in the blood in small quantities, and the same may be said of *oxalic* and *lactic acids*, and of *acetone*.

(*d*) *Bile*.—Certain of the constituents of the bile may occur in the plasma. The most obvious of these is the *bile-pigment—bilirubin*—which either by direct formation in the blood from the hæmoglobin, or more frequently by absorption from the liver, accumulates within the circulation, and gives rise to the colour of the tissues in jaundice. The *bile-acids—glycocholic* and *taurocholic acids*—are also, under certain circumstances, absorbed into the blood, where they may be detected with difficulty. They have a destructive effect upon the red corpuscles, and act further as a powerful poison to the tissues, possibly causing the severe symptoms which may occur in hepatogenous jaundice. *Cholesterin* is credited by some pathologists with being the cause of the same symptoms, and it has been found in the blood in increased proportion in some cases of severe jaundice. *See* CHOLÆMIA; and JAUNDICE.

(*e*) *Sugar*.—The sugar of the blood is increased in diabetes, in some cases reaching 0·3 to 0·5 per cent.—*melitæmia*; also after chloroform-inhalation, and the administration of amyl nitrite, chloral hydrate, and certain other drugs.

7. **Extraneous Matters in the Blood.** Besides its normal constituents and their products, the blood may occasionally contain certain matters entirely foreign to it, such as the numerous poisons which act either directly upon the corpuscles, or specifically upon the organism. These, entering the circulation before they exert their specific effect, are in many instances readily discovered by analysis. The acid compounds of hydrogen with sulphur, phosphorus, arsenic, and antimony, respectively, act as blood-poisons by depriving the oxyhæmoglobin of its oxygen; while carbonic oxide and nitric oxide unite with the hæmoglobin, and expel the oxygen from the corpuscles. It is a matter of speculation whether other so-called poisons, the nature of which is still obscure, do not enter the blood and there exert their primary effect, such as the contagium of acute specific fevers and other infectious disorders. Similar infective matters, produced in the tissues of the body itself, are believed to be absorbed in septicæmia, pyæmia, and other allied diseases, and numerous observations support the further belief that the presence of micro-organisms is intimately associated therewith. A somewhat similar infection may occur in malignant disease, the juices being mixed with the blood-plasma, but in some instances the process may be different, namely, by means of cells. We cannot expect to detect these cells readily in the blood *in transitu*. The same remark applies to embola, of whatever nature, and to blood-crystals.

8. **Organisms.**—The blood may contain a variety of vegetable and animal organisms, either foreign or peculiar to itself; the latter being called *hæmatozoa*. *See* HÆMATOZOA; CHYLURIA; and FILARIA SANGUINIS-HOMINIS; also MICRO-ORGANISMS; MALARIA; RELAPSING FEVER; SPIRILLUM; and ZYME.

J. MITCHELL BRUCE.

BLOOD, Transfusion of.—*See* TRANSFUSION.

BLOOD-WORMS.—This term is of general application. It refers to all kinds of entozoa living in the blood. *See* ENTOZOA.

BLUE DISEASE.—SYNON.: *Morbus Cæruleus*.—A condition in which the most prominent symptom is a peculiar discolouration of the skin and mucous membranes, due to the circulation of dark blood in the vessels. *See* CYANOSIS; and HEART, Malformations of.

BOILS.—SYNON.: Furuncles; Fr. *Furoncles*; Ger. *Furunkeln*.

DEFINITION.—Gangrenous inflammation of the skin, forming small painful swellings, and ending by expulsion of the necrosed centre or 'core.' The inflammation begins in the glandular structure, hence involving not only the skin, but also the cellular tissue immediately beneath. The sebaceous glands are most commonly the seat of boils, but occasionally the Meibomian glands (*stye*), the ceruminous glands, and the sweat-glands of the armpit are affected; or, more rarely still, the glands of the lips, vulva, or anus.

ÆTIOLOGY.—*General predisposing causes.* The general predisposing causes of boils are:—the male sex; youth and after middle life; a stout habit of body; seasons of spring and autumn; a diet too full of flesh, or one suddenly changed, such as that adopted during training for rowing, or in various forms of the so-called 'water cure.' To these must be added the vitiation of the blood during exhausting fevers and in certain cases of saccharine urine, or that induced by handling dissecting-room material; and by dirty occupations—for example, chimney-sweeping or rag-picking. Lastly, boils are sometimes epidemic.

Local predisposing causes.—The parts of the skin most exposed to dirt or chafing—the hands and face, the neck and back, the buttocks and knees—are favourite sites for boils; but they may form on any part except the palms and soles. Blisters, poultices, and stimulating liniments occasionally cause them.

Determining causes. — Following these predisposing causes is the specific contagion of a parasitic microbe, which, by developing in a gland-cell, or hair-bulb, causes limited necrosis (the slough) of the tissue in which it grows. This microbe is the staphylococcus pyogenes, which can always be detected in the discharge of a boil; and boils have been produced by inoculation of this micrococcus, artificially cultivated from the tissues of acute necrosis of bones to free it from other possible contagia.

SYMPTOMS.—Boils appear either singly, in succession, or several at once, forming then an eruption on the skin. The solitary boil begins with itching; soon a reddish pimple forms at the itchy point; sometimes the pimple is tipped with a minute vesicle, in the centre of which a hair may generally be detected. The pimple grows larger and harder, the red area increases and grows darker, and pain begins, stinging at first, then throbbing. In about five days the summit breaks, pus oozes forth, the pain abates, and the hardness diminishes. A day or two later the core, a shred of sphacelated cellular tissue, escapes. The boil then subsides and healing rapidly takes place; the scar is depressed, and for some time has a violet colour. Occasionally the inflammation affects chiefly the cellular tissue beneath the skin; the mass is then softer, more round and clearly circumscribed, and fluctuates like an abscess—this variety forms in the armpit. Rarely, the central slough extends rapidly beneath the surface, and communicates with the surface by several small apertures (resembling carbuncle). In other cases the swelling is more diffuse; no core appears at the surface, but a hard, very painful, pimple is formed, which is long in subsiding (*blind boil*). The furuncular eruption, consisting of groups of small boils, forms successive crops, and thus the disease may continue a long time. Boils are generally limited to a small region, but this is not always the case; and the greater part, even the whole, of the body may be attacked.

The constitutional disturbance is usually *nil* or slight when the boil is due to local irritation, though it may suffice to render nervous, irritable persons unfit for work. When the boils are in exhausted persons, the general symptoms are severe and denote great depression. Prostration, agitation, stupor, low delirium, dry brown tongue, sordes, vomiting, and diarrhœa set in, and the case often ends fatally: or recovery is very slow, accompanied by much suppuration. Septic absorption and pyæmia very rarely take place.

Carbuncular Boil of the Face.—There is a rare and generally fatal form of boil, the determining cause of which is still uncertain. Doubtless it is due to inoculation with a specific contagium not yet determined. It is met with only on the head and neck, notably on the lip. Mild and trifling at first, like an ordinary boil, it rapidly extends by inflammation of the cellular tissue and veins or lymphatics, and causes poisoning of the blood. The earliest sign of this fatal change is the occurrence of violent and repeated shivers. The boil becomes a boggy swelling of blackish-violet colour; the surrounding tissues become hard and brawny; suppuration ceases; sloughing occurs; the complexion grows earthy; the features, if the boil is on the face, become everted; the skin round the eyes in some cases is puffed out, and the eyes themselves project from the sockets; anxiety and laboured, gasping breathing set in; and a violent constricting pain in the head, chest, or belly is frequently experienced. Delirium and coma usually supervene, but sometimes consciousness and terrible suffering remain to the last. The duration from the first shiver to the end is about four days, though death may supervene in half that time. The veins of the face first inflame, and the phlebitis extends by the veins of the orbit to the sinuses in the skull, to the diploë, &c.; hence abscesses form in the eyelid, the forehead, the meninges, or the brain, and occasionally in distant viscera.

DIAGNOSIS.—A boil is distinguished by the central cavity and slough—characters peculiar to it. The boil of the face accompanied with phlebitis has been confounded in this country with the 'malignant pustule' of Continental surgeons. The former is still a *boil* with a central core. The '*pustule maligne*' is said to have invariably a large vesicle surrounding a brownish eschar, with a ring of smaller vesicles round the larger one,—a condition never met with in boils.

Prognosis.—When due to local causes, the prognosis is good, unless the patient be exhausted by old age or fever; under such circumstances the extensive sloughing and suppuration often lead to a fatal issue.

Treatment. — *General.* — First remove predisposing causes, and invigorate the patient by change of air, outdoor exercise, vapour and Turkish baths. The sanitary state of the patient's dwelling must be tested, as sewer gas may cause boils. The diet should be moderate and mixed. Alcohol, unless the patient is greatly debilitated, should be given in very moderate quantity, and the form of fermented liquor most habitual to the patient is best; much alcohol taken before the core has loosened increases the pain and throbbing. Occasionally a saline purge should be given. Of empirical remedies, yeast (a tablespoonful thrice daily) is said to put an end to the repetition of boils. Quinine and perchloride of iron are also used. Quinine should be given to an adult in five-grain doses every six hours, till singing in the ears and headache begin; it should then be gradually lowered for three or four days to three or four grains per diem, and finally left off. In obstinate cases the waters of Vichy, Barèges, or Harrogate are believed to remove the disposition to boils. In diabetes omission of sugar-forming food and the free administration of alkalis and opium are the most effectual remedies. For the exhausting boil of the face, large doses of brandy methodically prescribed, whether with or without quinine, are required, and copious nourishment by beef-tea, with peptonised foods in frequent doses.

Local.—When signalled by itching, a boil may be stopped by plucking out the hair of the inflamed follicle, and in a long succession many boils may thus be prevented. When the areola has formed, if the pain be slight a drop of caustic solution applied to the centre will sometimes check the progress of the boil. A better plan at this stage is to cover the boil with a galbanum and opium plaster (Erasmus Wilson's) spread on leather. Under this treatment pain at once ceases, the inflammation gradually subsides, and the separation of the core proceeds painlessly; when the boil discharges, a hole should be cut in the centre of the plaster, for the escape of the products. When the pain is stinging, and the areola wide, with restlessness and headache, warm poultices are most soothing —those of starch cause pustulation less than linseed-meal poultices. Mixing lard with a linseed poultice, or sprinkling it with the dilute solution of acetate of lead, has a similar effect. Extract of belladonna and glycerine in equal parts should be freely spread over the boil before the poultices are applied. Sponging with hot water also greatly alleviates the pain of boils, and may be continued for hours together. Poultices hasten the expulsion of the slough, but should be discontinued as soon as the hardness changes to doughiness, as they tend to excite fresh crops of boils in the skin near the first boil. If the slough is large, the surface may be dressed with lint spread with Peruvian balsam or dusted with iodoform, and the boil carefully protected by means of pads and compresses of carbolised tow. Poultices are now altogether abandoned by many surgeons; moist heat being applied by means of layers of boracic lint wrung out of hot water and covered with oiled silk.

Incisions are now much less employed than formerly. They increase rather than lessen the loss of tissue in ordinary boils, and do not shorten the duration of the inflammation. They give relief to pain, however, and check the spread of diffused boils. Incisions are therefore useful to relieve tension when severe. When made, incisions should be free, crucial, or even star-like, and carried beyond the boil. In the rapidly extending boil of the face simple incisions are of little avail: the free use of the actual cautery may be beneficial if employed at an early period; or if the boil be seen early, free excision of the boil and the healthy tissue around it may be made. Otherwise, quinine in large doses and local soothing applications give most relief. *See* Pustule, Malignant.

Berkeley Hill.

BONE, Diseases of.—Synon.: Fr. *Maladies des Os*; Ger. *Knochenkrankheiten.*—Under this head are included:—Acute and Chronic Inflammations of bone and its membranes, with the consequences thereof, such as Necrosis, Caries, and Abscess; New Growths, which arise both within and upon the bone; Malformations; and certain disorders of nutrition, namely, Hypertrophy and Atrophy.

Viewed in another aspect, bone diseases may be divided into two principal groups, which somewhat overlap one another, namely, (*a*) those which are distinctly *inflammatory* in type; and (*b*) those of *diathetic* origin.

Bone-tissue should be regarded as being similar to other connective tissues; but some diseases affecting it are rendered obscure by its structure, while others are materially modified in their progress, by reason mostly of its meshes being filled with lime-salts.

1. Inflammation.—As a matter of clinical convenience, it is usual to consider separately inflammations of the periosteum, of the bone proper, and of the medulla; but it should not be forgotten that these structures are throughout continuous and interdependent, and that disease is rarely exclusively confined to any one of them: it may originate or be chiefly developed in one, but it cannot long exist without involving the others to a greater or less degree. Whilst inflammation of bone is essentially the same as inflammation elsewhere, its characters are modified by the tissue in which it takes place, accordingly as it affects the periosteum, the compact or the cancellated tissue. The bones are most frequently affected by disease during the period of active growth, when the development is proceeding and the blood-supply abundant. The periosteum is especially vascular at this period; and as the bone derives its chief supply of blood through it, it powerfully reacts when inflamed upon the bone, and inflammatory changes taking place in the periosteum are very seldom limited to this membrane. Inflammation of the bone is very painful, from the unyielding nature of the tissue; and, when the inflammation has been sufficiently intense, the vitality of the bone is destroyed, and the dead portion is subsequently separated with some difficulty. So also in bone-disease dependent upon some general cause, such as syphilis, the characters of the disease may be modified or obscured by the mechanical conditions which obtain.

A. **Periostitis.**—*Inflammation of the investing membrane of bone.*—By periosteum is usually meant the thin fibrous envelope of the bone in which the vessels for the supply of blood subdivide. But between it and the bone is a layer of osteogenetic cells like the cambium-layer of a growing plant, and immediately external is a layer of cellular tissue, continuous with that of the adjacent parts; these are integral portions of the periosteum, and take an active share in all its diseased processes. Periostitis may be either *acute* or *chronic.*

(*a*) *Acute Periostitis; Osteoperiostitis; Acute Periosteal Abscess; Acute Necrosis.* This is a formidable, but fortunately comparatively rare, disease, at least in the adult. It attacks the long bones almost exclusively, usually those of delicate children or young adults, in whom active bone-growth is still going on, and the periosteum is highly vascular. Acute periostitis probably never occurs without coincident inflammation of bone, and it is by far the most common cause of necrosis. It will be best to regard it as an acute osteitis and periostitis combined, and to call it *osteoperiostitis*, just as we call inflammation of the bone and of the endosteum *osteomyelitis.* The extent to which the bone and the periosteum are in the first instance respectively involved is always difficult, and sometimes impossible, to determine—it may be inferred from the extent of the necrosis. There are two ways in which the disease may begin—either in the fibrous investing sheath of the bone and the cellular layers beneath and superficial to it, from whence it spreads inwards to the cortical bone-substance, or even to the medulla; or in the bone-tissue—the inflammation spreading outwards to the periosteum. It is impossible in the living subject to distinguish acute osteomyelitis and osteoperiostitis arising from idiopathic causes. The disease is usually attributed to an injury, often slight, or to exposure to extremes of cold or heat. Frequently no cause is assignable. The disease is in most cases associated with the development of a pathogenic micro-organism, the pus teeming with micrococci.

Pathology.—Rapid exudation takes place in the layers of the periosteum, and between it and the bone; also in the Haversian spaces and canals of the bone, often to such an extent as to obstruct the circulation, and probably to cause by pressure the severe pain complained of at the outset. The exudation beneath the fibrous layer of periosteum is copious, and soon becomes purulent; the periosteum is detached; the vascular supply of the bone is cut off; and necrosis results. Occasionally the disease originates at the epiphysial junction, commonly between the diaphysis and the epiphysial cartilage, less frequently in the layer of cartilage itself. The extent of the necrosis depends upon the extent to which the periosteum is engaged, while the thickness of the dead bone depends mainly on the depth to which the inflammation in the osseous tissue extends, sometimes the entire shaft perishing from one extremity to the other. Usually the diseased action is arrested at the epiphysial junction; but in other cases the extremity of the bone and the adjacent joint become involved. Large accumulations of pus, swarming with micrococci, are often rapidly formed in these cases, the pus escaping through openings in the fibrous envelope into the circumjacent cellular tissue, and finding its way to the surface. The shafts of the tibia and femur are the parts most frequently affected; the disease occurs more rarely in the bones of the upper extremities and other parts of the skeleton.

Symptoms.—One of the earliest symptoms of acute periostitis is sudden and severe pain in the affected bone, which is soon followed by rigor and intense fever. The temperature mounts quickly to 104° or 105° F. There is sweating, rapid feeble pulse, and delirium, aggravated at night. On the second or third day deep-seated swelling may be felt, somewhat obscurely at first; and the limb is swollen, hot, tense, and tender. An obscure sense of fluctuation may be distinguished at an early period; but when fluctuation becomes distinct very extensive damage will usually have taken place. After an interval varying from three to five days, the inflammation approaches the surface, the skin becomes œdematous, pits on pressure, and finally reddens and inflames. The length of interval depends on the thickness of muscles and soft parts covering the affected bone. Other things being alike in respect of pain and amount of fever, the longer the delay in the appearance of external swelling, the greater the probability that the bone is the first and chief tissue engaged, the inflammation having reached the periosteum secondarily; while the early appearance of swelling and fluctuation externally suggests that the inflammation is chiefly periosteal. Blood-poisoning, either septicæmic or pyæmic, is a common consequence of acute inflammation of bone and periosteum.

Diagnosis.—This disease may be obscure at the commencement, and its nature overlooked. It has often been mistaken for acute rheumatism, on account of the swollen joints; for phlegmonous erysipelas; for acute cellulitis, or for typhoid fever. The only malady with which acute periostitis need be confounded is an idiopathic inflammation of the deep-seated cellular tissue in a limb. This disease is rare. When we observe the chain of symptoms above described in a young person, we may safely assume the presence of an acute osteoperiostitis.

Course and Terminations.—The disease almost invariably terminates in suppuration and necrosis; resolution happens rarely, but necrosis is not inevitable, even after suppuration. In a fe casesw, especially in young children, if the matter be speedily evacuated, the abscess collapses, the periosteum reunites with the bone, and no necrosis takes place. This result is unfortunately quite exceptional. As the separation of the periosteum cuts off the vascular supply from the bone, unless incisions be very speedily made to permit the escape of inflammatory products, more or less extensive necrosis is the inevitable result. If not evacuated, the pus confined beneath the periosteum will presently escape through one or more openings into the intermuscular spaces, and in this way reach the surface. In favourable cases, after evacuation of the matter, the acute symptoms subside; new bone is formed from the deeper layers of the periosteum; and the dead part, finally invested with a sheath of new bone, becomes a sequestrum.

Prognosis.—This must be founded on the extent of the necrosis; whether blood-poisoning has taken place; and whether the adjacent joints are implicated in the disease. Cure cannot take place until the dead bone is cast off or removed, and this is often long delayed. The usefulness of a limb may be permanently impaired by the disease, or it may require amputation, or the patient may lose his life from the exhaustion of the discharge or some intercurrent malady. On the other hand, the use of the limb, and the health of the patient, may become completely re-established.

Treatment.—Early and energetic treatment is of the greatest importance, as it affords the best prospect of averting the disastrous consequences of acute periostitis, but in hospital practice the cases are rarely seen sufficiently early. In the first stage the limb should be elevated, and cold compresses applied. As soon as the nature of the affection is suspected free incisions down to the bone, so as to divide the periosteum, are indicated, even before there is clear evidence that pus is formed. They relieve pain and tension; and, by permitting the timely escape of pus as soon as it does form, the amount of periosteal separation, and consequently of necrosis, is limited. It is the more important to make an early incision, because evidence of fluctuation is at first by no means easy to make out; and an incision down to the bone should be made in the centre of the inflamed area in all cases of doubt. Antiseptic precautions should always be taken. Sometimes the abscess-cavity does not readily collapse, owing to its walls being stiff and infiltrated, and its contents may become septic, thus greatly increasing the patient's risks. If there be synovial effusion into a neighbouring joint, it should be kept at rest by means of a splint or a fixed bandage. As the acute symptoms subside, the abscess-cavity contracts, one or more sinuses remain, and the dead bone begins to separate. *See* Necrosis, page 174.

Where an epiphysis is engaged in the disease the case is more urgent; the fever runs higher, the suppuration is greater, and the degree of joint-implication more intense, proceeding in extreme cases to suppurative inflammation and destruction of the articulation. When the joint becomes tense and swollen, the fluid may be drawn off with a trocar and cannula, or an incision may be made into it. The affected limb should always be supported on a splint. Œdema of the limb often indicates a deep-seated phlebitis, the precursor of septic poisoning. Under these circumstances, amputation is often the only resource. It is imperative to amputate where there is extensive bone-destruction, and the symptoms indicate commencing pyæmia; or where, with the death of a large portion of the shaft, one or both of the neighbouring joints may have become gravely implicated, and great suffering and loss of strength forbid us to temporise. It is precisely in these cases, however, where the diaphysis has become necrosed up to the epiphysial junction, that good results are attainable by the immediate extraction of the dead bone. The part of the shaft which joins the epiphysis becomes rapidly detached and loose, and may be readily separated and removed, while the portion beyond the limit of the necrosis in the other direction can be divided with a chain saw. It is difficult, however, in the early stage to diagnose the extent of the necrosis. Where the joints both above and below are involved, amputation is usually necessary.

A periostitis of a very acute form, almost invariably suppurating, and accompanied by necrosis, is very common in the fingers, where it chiefly affects the ungual phalanges. The pain is very great, but may be relieved by an early and free incision down to the bone, which, nevertheless, does not usually avert either suppuration or necrosis.

(*b*) *Chronic periostitis.*—This disease is usually due to some diathetic cause, but may result from injury, or from some continuous pressure or source of irritation. It is most frequent on the superficial parts of the skeleton, as the tibia, clavicle, skull, and ribs, but may affect any bone; and it is often observed at the origin or insertion of muscles. When the disease arises from a general cause, such as syphilis, many parts of the skeleton are affected; when from a local one, usually only one.

Symptoms.—Chronic periostitis often takes the form of what is called a *node*—a tender, more or less painful, rounded or oval swelling; at first tense and hard, afterwards softer or even fluctuating. The pain is more severe at the outset, from the tension of the parts involved, and is generally worse at night. Subsequently the swelling becomes indolent, and painless, unless it be pressed upon; and the effused matter may become organised first into fibrous tissue and then into bone. Nodes are due to a localised inflammation. The cambium-layer of the periosteum and its external layer proliferate and become filled with leucocytes, thus forming a well-marked projection on the bone, which may undergo resolution, suppurate, or ossify, according to circumstances.

Prognosis.—In chronic periostitis this is usually favourable. Under the influence of early and suitable treatment, the inflammatory products are completely absorbed, and the bone resumes its natural shape. If the chronic inflammation of the periosteum be permitted to proceed unchecked, a deposit of new osseous lamellæ usually takes place on the surface of the affected bone, giving rise to permanent thickenings, or even to osteophytic growths. These are composed of light porous bone, with a rough surface. The skeleton of a syphilitic subject will often present numerous thickenings of this nature. On making a section of the bone, it is easy to see that the new bone is superimposed upon the old, and is formed by the periosteum.

Treatment.—When due to a local cause, the swelling will often spontaneously subside with removal of the cause and rest to the part; but in obstinate cases iodide of potassium internally, and iodine ointment or blistering externally, may be required. If the subject be unhealthy, or if the original injury be considerable, suppuration may take place, when the treatment will be that of an inflammatory abscess. *Syphilitic nodes*, which are a very common expression of chronic periostitis, yield rapidly to the influence of iodide of potassium; and this in some cases may usefully be combined with a mercurial course. Blistering or friction externally is hurtful in such cases. Syphilitic nodes are not at first prone to suppuration, and even when they become soft and fluctuating, and the skin reddens over them, they should not be mistaken for abscesses, as they do not require incision, and will readily be absorbed under suitable treatment.

(*c*) *Periostitis after typhoid fever.*—A peculiar form of chronic periostitis is occasionally observed as a sequel of typhoid fever. It occurs during convalescence, and without general symptoms. It takes the form of hot, painful, and tender nodes, frequently symmetrical, and often placed on the tibia; the disease is also found on the ribs and other bones. It may be associated with necrosis, but if so the extent of the dead bone is small in proportion to the inflamed area of periosteum. The general health is not seriously affected by the periostitis, and the disease is amenable to treatment by iodide of potassium, combined with iodide of iron.

(B) **Osteitis.**—Osteitis is an inflammation chiefly affecting the bone-substance. It may be either *acute* or *chronic.*

(*a*) *Acute osteitis* is neither clinically nor pathologically to be distinguished from acute osteomyelitis or endosteitis. *See* (C) Osteomyelitis. p. 171.

(*b*) *Chronic osteitis* is a disease beginning in the bone, in which from first to last the chief changes occur, the periosteum being secondarily engaged. This affection may result from injury, or be excited by exposure to cold; but it often depends on constitutional predisposition, such as the syphilitic, the strumous, the gouty, or the rheumatic diathesis, the first being the most frequent cause. It may occur in any part of the skeleton; the chief changes, when produced by syphilis, occur in the shafts of the long bones. They consist mainly of hypertrophy, and the bone is ultimately increased in thickness, in length, and generally in density: its interior is often transformed into sclerosed bone-tissue, and the medullary cavity is obliterated. Another form, associated with the strumous diathesis, is generally seated in the joint-ends of the long bones, and in the spongy bones. It is prone to end in suppuration, accompanied by either caries or necrosis, or may terminate in the condition known as *osteoporosis* or *rarefying osteitis.* The gouty and rheumatic forms are associated with evidence of the presence of either of these diatheses.

Pathology.—Increased vascularity first takes place, the Haversian canals enlarge, the canaliculi disappear, the cancelli enlarge to contain the inflammatory products, and the earthy matter diminishes. Hence the inflamed bone softens, and, if macerated at this stage, will be found comparatively light and porous. When the inflammation affects the superficial laminæ of the bone, the periosteum becomes thick and vascular; if the deeper parts are involved, similar changes will occur in the endosteum. The porous condition of the bone may become permanent, when the condition is called *osteoporosis*, the result of so-called rarefying osteitis; or the granulations become transformed into new bone, and the cancellated structure is filled with osseous deposit, so that the whole of the inflamed area becomes very dense, and is then said to be sclerosed; or the inflammatory process may terminate in suppuration, followed by caries or necrosis; or an abscess may form in the interior of the bone, and be either diffused or circumscribed.

Symptoms.—These are insidious, very obscure at the outset, and may be mistaken for those of chronic rheumatism, or mere periostitis. They consist chiefly in aching, gnawing pain in the affected bone, with characteristic remissions and nocturnal exacerbations. The bone is tender on pressure, and feels increased in bulk at first, from the infiltration of the immediately surrounding soft tissues; subsequently the bone itself enlarges. There is often increase of heat in the limb. The progress is chronic. If unchecked by treatment, chronic osteitis may give rise to considerable deformity.

Treatment.—Treatment should be directed to the cause of the disease. If this be syphilis, antisyphilitic treatment will be followed by good results; even in chronic bone-inflammation not dependent on syphilis, iodide of potassium is often of great service. Local counter-irritation may also be employed. Often the cause cannot be made out, and if iodide of potassium fail in producing an effect we must fall back on general treatment. In the early subacute stage, rest, with elevation of the affected part, is very desirable. Warm fomentations, followed by iced compresses, relieve the suffering. If there be much pain and tension, leeches should be applied. Puncturing the tissues down to the inflamed bone, with a tenotomy-knife or fine bistoury, relieves the tense periosteum, and allows extravasation beneath it to escape, so that the pain promptly abates.

(*e*) *Osteitis deformans.*—A peculiar form of chronic inflammation of bone has been described by Sir James Paget under this title, from the changes it produces, both in the form and density of the affected bones. It is a chronic osteitis of the most extensive kind. The compact tissue is chiefly affected, becoming thickened, soft, spongy, and vascular; the Haversian canals are enlarged, and contain granulation material. It begins after middle age, and may continue for an indefinite time without influence upon the general health—a feature which distinguishes it clinically from other bone-inflammations. It is usually symmetrical, and affects chiefly the long bones of the lower extremity and the skull. At first the bones enlarge and soften, from excessive production of imperfectly developed granulation-tissue and increased blood-supply; and, yielding to the weight of the body, they become curved and misshapen. The femur, for example, shows a marked anterior curvature, and its neck becomes horizontal; the spine becomes curved; the skull is enormously thickened. The limbs, however, although deformed, remain strong and fitted to support the body. In its early period, and sometimes throughout its course, the disease is attended with pains in the affected bones, which vary much in severity, and are not especially nocturnal or periodic. It is not attended by fever, nor associated with any constitutional disease. It differs from the chronic osteitis dependent on simple inflammation of bone, or that produced by gout or syphilis, in affecting the whole length of the bone; whilst hyperostosis and osteoporosis dependent on these latter causes rarely affect the entire bone. No treatment appears to produce any effect upon this disease.

(C) **Osteomyelitis.**—This is an inflammation chiefly affecting the endosteum and interior of the bone. Like osteitis, it may be either *acute* or *chronic*.

(*a*) *Acute osteomyelitis* or *endosteitis* is a suppurative inflammation of the medulla and bone, which is very frequently associated with septic poisoning and necrosis. We must remember that the medulla of a long bone is very vascular; it consists of fat and numerous white corpuscles contained in a delicate connective tissue. Near the cortical part of the bone the connective tissue assumes a very vascular membranous form, which has been called the endosteum. The disease nearly always arises in connexion with bone-injury, and most frequently happens after amputation, or gunshot fracture, in which the cancellated structure is injured; a severe contusion of the bone, an injury to the periosteum, or exposure to sudden extremes of heat and cold, is capable, under some circumstances, of producing the disease.

Symptoms.—The symptoms are obscure, more especially if there be no opportunity of inspecting the affected bone, as the changes in the bone are often masked by inflammation of the superficial parts. They usually make their appearance from five to ten days after the injury to the bone; in some cases much earlier. The pain may not be excessive; there is fever and probably rigor. If there be a wound, the secretion from it diminishes in quantity, and becomes less healthy; the medulla protrudes from the central cavity; the parts soon become surrounded by putrescent fluid; and the symptoms resemble those of more or less intense septicæmia. The periosteum generally, but not always, separates from the bone. In young persons the disease is sometimes arrested at the epiphysis; but in the adult the whole length of the bone is liable to be affected. The risk of septic poisoning is infinitely greater in osteomyelitis than in osteoperiostitis. Thrombosis of the bone-veins is especially prone to happen, and by the breaking down of the clot septic emboli are carried into the circulation, and deposited in the liver, lungs, and elsewhere. In this disease, too, fatty embolism often takes place —a condition associated with a very acute and fatal form of blood-poisoning. The prognosis is generally bad. It may be impossible at first to distinguish acute osteomyelitis from acute osteoperiostitis, arising from non-traumatic causes. In military hospitals, in war time, acute osteomyelitis is often epidemic, and probably of septic origin.

Treatment.—Where the symptoms lead us to suspect osteomyelitis, although the medullary cavity of the bone may not have been exposed, it will be desirable to trephine the bone, and if suppuration in its interior be discovered, it becomes necessary to amputate as soon as the nature of the disease is recognised, and this affords the best chance of saving the patient's life. The chief difficulty consists in arriving at a correct diagnosis, and deciding when it becomes necessary to interfere. This may best be done by observing the general progress of the case; and locally by the introduction of a probe into the medullary cavity when this is exposed. Should it reach healthy bleeding medulla near the surface we may temporise, if the constitutional symptoms admit of this; but it is rare for the disease once commenced to be limited—it has an extreme tendency to become diffused. Experience shows that nothing short of amputation at the next joint, or even above it, is sufficient to arrest the consequences of the malady; and to be successful this must be done before the systemic poisoning has become marked. Amputation in the continuity of the affected bone is worse than useless.

(*b*) *Chronic osteomyelitis* is an obscure affection, not to be distinguished, either clinically or pathologically, from chronic osteitis. It may terminate in sclerosis, or in the formation of an abscess. *See* Chronic Osteitis, p. 170.

2. **Abscess.**—This is a term usually applied to a limited suppuration in the bone, unattended by necrosis. Young adults are most prone to the disease, or boys about the age of puberty; it is very rare in women. It is the result of a chronic inflammation of bone, which may be associated with some injury. This affection is most frequently met with in the upper and lower extremities of the tibia, just external to the epiphysial cartilage, less frequently in the ends of the femur, only occasionally in other bones, and very seldom in the compact tissue anywhere.

Symptoms.—A circumscribed, slightly elevated, very tender and painful swelling may be discovered on the surface of the bone. This is due to a local periostitis with new bone-deposit. In old-standing cases the bone is often half an inch or an inch longer than its fellow, by reason of the chronic hyperæmia and consequent increase of activity of growth at the epiphysis. The skin and superficial parts are unchanged at first, or there may be but trifling subcutaneous œdema. There is often slight local increase of temperature. The pain, aggravated on deep pressure at the central point, is often intolerable. It is intermittent at first, but generally worse at night. After a time it becomes continuous, and deprives the patient of all rest, owing to its severity. The abscess may persist with little change for months or years. The symptoms generally resemble those of osteitis, from which at the outset it is difficult to distinguish this affection. When the abscess tends to reach the periosteal surface, the soft parts become engaged, and there will be slight redness and œdema of the skin. More rarely the pus makes its way into the adjacent articulation, in which it sets up destructive inflammation; but usually the joints are free from implication. The subjects of the disorder have often suffered from antecedent bone-disease. Evidence of this should be looked for, as giving a clue to the diagnosis.

Treatment.—Spontaneous cure cannot occur: even if the abscess discharge itself, a permanent fistula will usually remain. It is necessary to lay the abscess-cavity freely open. A crucial incision must be made through the soft parts, down to the bone, at the most tender and prominent point, and a disc of bone removed by the bone-trephine—an instrument without a shoulder, about half-an-inch in diameter. The sudden loss of resistance indicates the piercing of the abscess-cavity. The layer of granulation-tissue lining its interior should not be interfered with, but the cavity simply washed out. The pus is often foul, and greenish in colour. The wound should be dressed antiseptically; granulations presently fill it, which are subsequently transformed into a fibrous cicatrix. Immediate and permanent relief follows the operation. If the abscess is missed, the trephine may be re-applied, or drill punctures made in the most likely directions in the adjacent bone, in order to discover the pus. Sometimes an error of diagnosis is committed, and the symptoms are found to arise from chronic osteitis, without suppuration. The operation, nevertheless, affords relief in these cases also. Where there is doubt, a preliminary course of iodide of potassium will often resolve it.

3. **Caries.**—Caries is a form of chronic inflammation resulting in osteoporosis and suppuration, with gradual disintegration of bone, which has been likened to the process of ulceration in the soft tissues. It is generally found in the spongy bones, in any part of the

skeleton, the vertebræ and tarsus being the parts most commonly affected. There are two forms of the disease: the one, *simple caries*, resembleing an indolent ulcer of the soft parts, is most common in the flat or short bones, but is sometimes met with in the compact tissue of long bones; the other, *fungating caries*, is often met with in the articular ends of the long bones, and usually terminates in joint-disorganisation. It has been called *subarticular caries*; and is part of the disorder known as *tumor albus*, a form of tuberculous disease (*see* JOINTS, Diseases of). The non-articular form of simple caries often originates in a localised periostitis, and is frequently due either to syphilis or struma—the latter is most frequent in young persons, the former in adults.

PATHOLOGY.—In caries the bone gradually disintegrates as the result of a chronic inflammation of its cancellated tissue. The trabeculæ become invaded with leucocytes; the Haversian canals, lacunæ, and canaliculi enlarge from the same cause; and granulations form, which prove, on an exposed surface, the source of purulent discharge, just in a granulating surface of the soft parts. The process is, however, interfered with and delayed by the act of getting rid of the osseous structure, between the trabeculæ of which the cells remain shut up until the bone-tissue finally breaks down, and comes away in the discharges, being often distinguished in the form of gritty particles. Until this process is completed the dead bone is soaked in pus, which often becomes putrid, and until it is got rid of a healthy granulation-surface is impossible. Caries is frequent in scrofulous subjects, and is then due to a deposit of tubercle in the cancellated tissue. Syphilis is a frequent cause of caries, the bone being infiltrated by gummatous material. Fungating caries occurs in the epiphyses of the long bones; the fungating granulation-tissue perforates the cartilages and invades the synovial membrane. The cancelli are rapidly filled up, and the granulations, on reaching the joint-surface, form fungating projections. Exposed to pressure, the softened bone-tissue yields and wastes away. In some joints, especially the shoulder, this may take place without the occurrence of suppuration—a condition known as 'dry caries.' More frequently purulent disintegration of the granulation-tissue occurs, and the disease presents the form of ordinary suppurating caries, or ulceration of bone. In other cases the inflammatory products undergo fatty degeneration and caseate, and portions of the bone necrose—'necrotic caries,' which occurs in connexion with both syphilis and tubercle. When recovery takes place, the granulation-tissue is in part absorbed, and partly transformed into fibrous material and new bone. A carious bone is soft and porous; the cancelli are thinned or destroyed, the spaces enlarged, and portions of necrosed bone are often found in the midst—a condition also known as necrotic caries. On section, a pink, gelatinous granulation-material is seen, often caseating towards the centre. In dry caries the granulation-tissue is pink and gelatinous throughout. An abscess-cavity may form in the interior, with portions of necrosed cancellous bone in its midst. The cause of this chronic inflammation of bone is usually the deposit of tubercle in the cancellous tissue. Nodules of tubercle are to be found in the granulation-tissue which has invaded the bone, as well as in the surrounding soft parts, containing in their centre a giant-cell with branching processes, surrounded by lymphoid corpuscles. The spinal bones are most frequently affected; next, the expanded extremities of the long bones in the lower limb and the bones of the foot; lastly, those of the upper extremity.

SYMPTOMS.—Caries is very chronic in its progress, and often causes extensive damage to the bone, involving the destruction of a joint, or loss of a limb. It is almost always associated with an impaired condition of general health. The adjacent soft parts are involved in the inflammation; abscesses form in them, generally connected with the diseased bone; these burst or are opened; and sinuses lined with gelatiniform granulations, and discharging a thin pus, persist for an indefinite time. On examination with the probe the surface of the bone is felt bare, rough, and much softened; and outside the area of carious bone periosteal deposits of newly-formed osseous tissue are often found. The diagnosis and prognosis depend upon the age, constitutional condition, and clinical history of the patient, as much as on the local signs.

TREATMENT.—This must be directed to relieve the constitutional taint, as well as the local disease. Merely to excise or destroy the diseased portion of bone is not always sufficient to cure the patient. Local means prove efficient only when the general condition has been sufficiently ameliorated, especially in the unhealthy chronic inflammation of bone frequently called strumous. Fresh air, good food, and tonics are, therefore, of great importance. If syphilis be present, an anti-syphilitic treatment must be pursued. The principle by which the local means act is to facilitate the formation of a healthy granulating surface—to transform, in fact, an indolent into a healing ulcer. The disintegration of the dead and diseased trabeculæ must be assisted. For this purpose the application of strong sulphuric acid diluted with two or three parts of water, or some other mineral acid, often proves useful. Partial gouging out of the diseased bone seldom succeeds, because of the injury done by the instrument to the adjacent bone, weakened as it is by inflammatory changes, and therefore prone to set up fresh disease. The complete *évidement* of the bone, leaving nothing but its thin outer shell, is more successful; but when the disease begins to invade adjacent joints, as in the tarsus, excision of the entire bone is best; or when several bones are involved, amputation of the whole part involved becomes necessary. In children operations of this kind are not so often required; general treatment frequently proves sufficient. In the early stages the actual cautery, applied over the most painful spot, is a valuable counter-irritant. When it is undesirable to make early incisions into strumous abscesses in connexion with diseased bone, it is right to empty them by a small trocar, so as to preserve the diseased area as long as possible from atmospheric influence, and meanwhile to improve the general health. When they require to be opened, this should be done under antiseptic precautions, and the whole of the diseased tissues must be scraped away with the sharp spoon. Iodoform dressing is the best. When the carious action is arrested, the cavity fills with healthy granulations, the sinuses close, the parts cicatrise, and the gap in the bone-tissue is filled by fibrous or sometimes by osseous material.

4. **Necrosis.** — The complete arrest of nutrition in a portion of bone from any cause is followed by the death or necrosis of the bone, and by a series of inflammatory changes in the adjacent parts, which result in the complete separation of the dead from the living tissue. It is a common result of the acute inflammation of bone which is invariably connected with some septic or infective cause.

ÆTIOLOGY.—Necrosis is most frequently the result of acute bone-inflammation or severe injury, as after amputation, compound fracture, or contusion. It is especially prone to happen in the compact tissue, but it also occurs in the spongy structure, as the joint-ends of the long bones, or the tarsus and carpus, where it is usually associated with more chronic forms of inflammation, and is more limited, as in necrotic caries. The peculiar nature of the blood-supply to bone, and the facility with which it may be interfered with or arrested under the pressure of inflammatory exudation, go far to explain the frequency of necrosis as a result of bone-inflammation. Acute suppurative osteoperiostitis or osteomyelitis rarely terminates without necrosis. Whether the dead bone will be in the superficial or the deep lamellæ, or include the whole thickness, depends on the seat of the inflammation, and on the extent to which the periosteum and endosteum are respectively implicated. The long-continued action of crude phosphorus, as observed in match-makers, and also of mercury, may induce necrosis. Syphilis is a frequent cause of necrosis, through its tendency to produce chronic osteoperiostitis, the sclerosed bone thus originated being afterwards prone to necrose. It is not an uncommon sequel during convalescence from some eruptive and continued fevers. After scarlatina, osteoperiostitis, followed by necrosis, is by no means rare, although affections of the joints are more common. It is probable that many cases of necrosis occurring in childhood are connected with an antecedent attack of scarlet fever. The nasal bones may necrose as the result of severe coryza, the vertebræ after pharyngitis, or the petrous portion of the temporal bone as a consequence of otitis. Arterial thrombosis and embolism are occasional sequelæ of typhus, and may produce a local gangrene, not only of the soft parts, but of bone. This is, however, more frequent in connexion with typhoid fever. In endocarditis the nutrient artery of a bone has been observed to be obliterated by an embolus, thus producing necrosis.

PATHOLOGY.—After the death of a portion of bone, the living tissue, in immediate contact with the dead, becomes inflamed. The Haversian canals and canaliculi become distended with migratory cells; the leucocytes multiply, and by degrees consume the hard substance of the bone; the trabeculæ are absorbed or eaten away; loops of capillaries form from the pre-existing vessels: a granulating surface, in fact, is formed in the layer of living bone, surrounding or in contact with the dead, in a manner precisely similar to what takes place in the soft parts when a slough is being detached. The periosteum separates from the bone, and becomes thick and vascular, while the osseous surface beneath is smooth and white, like macerated bone. In cases of syphilitic necrosis, as well as in that resulting from phosphorus, the surface is rough from antecedent periosteal deposit, and in the former the interior may also be sclerosed. How the osseous trabeculæ are dissolved or disintegrated at the surface of separation, so as to loosen the dead bone, is not certain. Probably the granulation-tissue that forms from the living bone possesses amœboid properties, and thus disposes of the calcareous particles. The pus that is formed has a mechanical influence, while according to one theory lactic acid is produced, which transforms the insoluble into soluble salts of lime. While this loosening process is going on, new bone, formed chiefly from the periosteum, which becomes thick and vascular, is being deposited, constantly becoming thicker, and with one or more openings in it for the escape of pus, called *cloacæ*, so that eventually the dead portion becomes completely invaginated, and is named, from its position, a *sequestrum*. This sequestration of the dead bone is not invariable. For instance, in the spongy bones, the bones of the skull, and the upper jaw, or where from any cause the periosteum has been destroyed, no sheath of new bone will be formed. Necrosis very rarely takes place without suppuration; when this does happen the nature of the case is very obscure. It has been aptly called 'quiet' necrosis. Occasionally nearly the whole shaft of a long bone has been found necrosed, and after an interval of months, or even years, no suppuration may have taken place. Such forms of necrosis are usually central and limited in extent. They may very closely simulate malignant disease, and often cannot be relieved or even recognised save after amputation. A chronic osteitis, followed by hypertrophy and sclerosis of the bone, is the most common antecedent condition of this form of necrosis.

Treatment.—The changes already described, which separate the dead bone from the living, do not cause its expulsion from the body. On the contrary, they shut it up, like a kernel within its shell, and nothing so imperatively demands surgical interference as the presence of necrosed bone. It acts as a foreign body, is a constant source of risk to the patient, and should be removed as soon as practicable. Its continued presence excites the periosteum to further formation of bone, so that the invaginating sheath becomes of great thickness in old-standing cases. The period at which an operation is usually undertaken is when the sequestrum has become loose, and the time required for this purpose varies with the extent of the necrosis. In the actively growing bones of the young, especially when the sequestrum involves the epiphysial junction, the process of separation is accomplished more quickly than in the adult. Roughly estimated, a period of from three to six months might be named as that within which loosening of the sequestrum usually occurs. Beyond the latter term an effort to extract the dead bone should not be delayed, even if it cannot be felt to be loose. Among other risks involved by delay may be that of amyloid degeneration of the viscera, principally the liver, kidneys, and spleen, which are subject to this change as the consequence of long-continued discharge from bone-disease. In order to remove a sequestrum, a director should first be introduced through a cloaca as a guide, and the soft parts sufficiently divided. An adequately large opening must now be made in the encasing sheath of new bone with the chisel, trephine, small saw, or cutting-forceps, and the dead bone extracted, either in one or several pieces, as may be the more convenient. The operation may prove difficult on account of great thickness of the soft parts or of the sequestral envelope, or because the sequestrum itself is extensive. After the removal of the dead bone the cavity fills with granulations, which subsequently ossify, and the soft parts cicatrise. When the loss of bone-substance is very large the reparative process has been much facilitated by the implantation of small pieces of freshly killed rabbit's bone. Finally the sequestral envelope of new bone is partly absorbed, partly consolidated, just as the redundant callus is after fracture, and the bone tends more or less to resume its normal size and shape.

5. **Tubercle.**—An examination of some cases of chronic bone-disease in scrofulous subjects seems to prove their connexion with the formation of tubercle in the bone. The cancellated tissue in the joint-ends of the long bones, and cancellated bone generally, are chiefly affected. Miliary tubercles, precisely similar to those found in other parts, are formed in the soft structure of the medulla. These may become confluent, and tend to caseate or undergo a fatty degeneration. The caseous mass only differs from a similarly produced mass elsewhere by reason of the necrosed bony framework which retains it. When macerated, the bone shows a rounded cavity, from which the tubercle has been discharged. The external appearances are those of fungating caries; but microscopical examination discloses multitudes of round cells like lymph-corpuscles, with protoplasmic matter, filling up the interspaces, and enclosing one or two giant-cells. The cells are found surrounding the soft, grey, non-vascular patches, which are often seen on section of an inflamed cancellated bone in strumous individuals, and this central part may be the subject of calcareous, fatty, or suppurative changes. The bone when so affected undergoes osteoporotic changes, and is never sclerosed; hence these are not simply cases of chronic inflammation.

Treatment.—In cases of this kind general tonic treatment becomes of the greatest importance. Rest must be given to the affected part, and exercise to the body generally, combined with fresh air both day and night, and simple nourishing food. When the bone is extensively diseased, it must either be excised, or the part amputated. The presence of the tuberculous diathesis does not forbid an operation, the local source of irritation and drain upon the system being thus removed, and a healthy traumatic surface substituted for one infiltrated with inflammatory products. The removal of the local disorder often proves a comfort to the patient; increases his chance of regaining health and strength; and diminishes the liability to dissemination.

6. **New Growths.**—The bones are liable to be the seat of most of the tumours found elsewhere in the body. The most important, and the most frequently occurring, are the sarcomata.

(*a*) **Myeloid Sarcoma.**—Some forms are peculiar to bone, as, for instance, the myeloid sarcoma, so called from the many large nucleated corpuscles contained in it, analogous to those found in fœtal marrow; it is of endosteal origin, causing an expansion of the bone in which it grows. It is most common in the inferior maxillary bone, and near the epiphysial ends of the long bones. It is generally observed in young persons; requires removal; and extirpation, if complete, is not, as a rule, followed by a return of the disease.

(*b*) **Periosteal or Fasciculated Sarcoma.**—This tumour, springing from the periosteum of a long bone, such as the femur, is not uncommon. The shaft of the bone may be seen on section passing through the centre of the tumour. Numerous bands of fibrous tissue, often ossified, radiate from the periosteum through the growth, like an outspread fan. The cells are spindle-shaped or round in form, of various sizes and in different proportions. This form of sarcoma is malignant. The best treatment is amputation of the limb at the joint above, which does not, however, ensure against recurrence of the disease.

Carcinoma.—This does not occur as a primary growth in bones.

(*c*) **Exostosis.**—This is a bony outgrowth developed on any part of the skeleton. It is difficult to distinguish cartilaginous from osseous outgrowths. The two structures are often mixed, and a tumour originally cartilaginous is often transformed into bone. Cartilaginous outgrowths, called **Ecchondroses,** are met with on the costal cartilages of old persons, also on the intervertebral discs, near the synchondroses, and arise also from the articular cartilages in osteoarthritis. Cartilaginous tumours, growing either from the periosteum or the medulla, have their favourite seat upon the phalanges; they are usually multiple, and from the deformity and inconvenience they produce often demand either enucleation of the tumour, or, in extreme cases, amputation of the finger. Chondromata also arise from the scapula and the shafts of the long bones, when they often become mixed with sarcomatous tissue. The more special forms of exostosis are of two kinds, the *spongy* and the *ivory-like*. *Spongy exostosis* is often developed near the articular ends of the long bones, where it forms a nodulated outgrowth of cancellated bone of variable size, encrusted with a thin layer of cartilage, by means of which it grows, and having generally a bursa superimposed. This kind of exostosis is often met with near an epiphysial cartilage, and ceases to grow when the bone is fully developed. This fact, as well as the proximity of the neighbouring joint, renders surgical interference often unnecessary, and it may be hazardous. Another form of spongy exostosis, sometimes called *osteophyte*, depends on a local excessive periosteal growth of bone. At first this outgrowth is porous, and but slightly connected with the bone on which it is developed. Afterwards it may become dense and hard from interstitial deposit, or it may always remain spongy. Such exostoses often depend on some local exciting cause, such as a blow; or they may be found at the insertion or origin of a muscle, as in the so-called rider's bone, at the origin of the adductor longus muscle, or the exostosis frequently found at the insertion of the adductor magnus, or the 'exercise bone' of the German soldier. They may be regarded as morbid exaggerations of the normal tuberosities of the skeleton. *Ivory exostosis*, so called from its dense, eburnated character, is more rare. It is found on the flat bones, and especially the cranium. It varies much in size, and may be pedunculated or sessile. Hereditary influence appears to exist in some cases, in others a predisposition to chronic periostitis, but there may be no apparent cause. The development is slow and painless.

Treatment.—Interference is seldom required in the spongy exostoses, except on account of pain or loss of function. When pedunculated, they can be broken off or divided subcutaneously; and although they may reunite, it will probably be in a more convenient and painless relation to adjacent parts. Otherwise they should be excised.

Except on account of deformity, or of pressing on important structures, an ivory exostosis should not be meddled with. It can often, however, when necessary, be enucleated; or where only a partial removal is possible, the low vitality of the tumour often leads to necrosis and subsequent exfoliation of the remainder. Spontaneous necrosis also occasionally occurs.

(*d*) **Osteo-aneurysm.** — Certain sarcomata and myeloid tumours, when very vascular, pulsate, and have been mistaken for aneurysm. There are, however, undoubted cases of aneurysmal tumours dilating the bone, which have been cured by ligature of the main vessel of the limb. When the tumour is small it may be excised, or the actual cautery applied. Sometimes amputation is required. The causes and pathology of the disease are obscure. It is probably in some cases of a nævoid nature.

(*e*) **Bone-cysts.**—These are tumours distending and thinning the bone, and filled with serum or bloody fluid. In some rare cases they contain hydatids. The origin of bone-cysts is obscure; some originate in the dentigerous cavities of the maxillæ, in which bone-cysts are most frequent, but they are sometimes found elsewhere. A very slow, painless increase in size takes place. The bone becomes gradually very thin, and often affords on pressure a peculiar and characteristic parchment-like crackling. In obscure cases an exploratory puncture should be made.

Treatment.—This consists in freely laying open the cyst-cavity, and providing for subsequent drainage. The cavity gradually contracts and becomes obliterated.

(*f*) **Hydatids.**—The formation of echinococcus-cysts is exceedingly rare in bone, compared with other parts of the body. The causes are unknown, and the symptoms very obscure, resembling those of an ordinary cyst. A cavity is formed, usually in the spongy extremities of the long bones, to contain the mother cyst. But it is also found in the medullary canal. The affection is grave. Serious inflammation often follows interference with these entozoa. It is sometimes difficult to remove the whole disease; and unless this be effectually done, a relapse will occur; while in such parts as the pelvis art is unavailing. The cavity should, if possible, be freely laid open, and all the cysts carefully removed or destroyed. The actual cautery may be sometimes employed with advantage, or the surface of the adjacent bone removed, as it may be invaded by the cysts. An exploratory puncture can alone resolve the diagnosis, by finding the hooks of the acephalocyst in the fluid.

g. **Actinomycosis.**—This disease arises from the transmission to man of a vegetable parasite formed in the calf (*see* ACTINOMYCOSIS). Its development in bone mainly occurs in the jaws (generally the lower), in which it causes great swelling. The jaw is distended by a mass of material chiefly inflammatory—consisting of a fibrous basis which is riddled with tracts occupied by the fungus. When suppuration occurs, the abscess-cavity presents the appearance of meshwork. The mode of infection may be either through the respiratory or digestive tracts, or by the socket of a diseased tooth.

7. **Malformations.**—These consist in any departure from the normal type of the skeleton, by reason of excess, deficiency, or irregularity, either congenital or acquired. It is not necessary to more than allude to the facts that the skeleton is often defective in parts; that senile changes occur, especially in certain bones; and that supplementary bones and processes are met with. Various deformities occur in bones from fractures, both intra-uterine and subsequent to birth, and from curvatures due to rickets or softening. Treatment of curvature consists in gradual straightening by splints or other apparatus, or immediate straightening under chloroform, methods which, in the soft growing bones of the young, prove successful in abating many deformities. The curvatures of adult bones do not yield in this way. When there is loss or impairment of function from deformity, the bone may be safely divided subcutaneously with the chisel or saw, and the limb straightened—often with admirable results. Forcible fracture is a clumsy and somewhat dangerous method, as the force employed cannot be regulated.

8. **Hypertrophy.**—Hypertrophy means an excessive growth of bone-tissue, increasing the bulk of the bone, the added bone completely reproducing the normal structure. Apart from inflammation hypertrophy is rare; but in museums specimens of excessive growth are met with, especially of the bones of the face and skull. The causes of this rare condition are unknown, and no treatment appears available. *See* ACROMEGALY.

9. **Atrophy.**—This disease consists in a diminution of the size or compactness of a bone. It may be the result of inflammatory changes, of senile degeneration, of disuse of a limb, of continuous pressure, or of an injury—such as a fracture—followed by non-union. The bone-tissue gradually wastes away, the cortical portion often becoming a thin parchment-like layer of bone, filled with soft medulla. This has been called *excentric atrophy.* The external appearance and size of the bone remain unchanged. *Concentric atrophy*, where the size of the bone diminishes in all its dimensions, may occur in bones which have been disused for lengthened periods, as from paralysis of a limb, disease of a joint, the bone in a stump, or un-united fracture. *Spontaneous fractures*, or fractures due to trifling causes, are very common under these circumstances. The term *fragilitas ossium* has been applied to this condition of bone-tissue, which also frequently occurs in cases of cancerous cachexia.

10. **Softening.**—This change occurs in rickets and mollities ossium. *See* RICKETS; and MOLLITIES OSSIUM.

WILLIAM MAC CORMAC.

BORBORYGMI (βορβορύζω, I grumble). Rumbling sounds produced in the abdomen by the movements of gas within the bowels or stomach. *See* FLATULENCE.

BORDIGHERA, in Italy, on the Riviera.—A suitable winter residence for patients suffering from some forms of chest-disease. The climate is warm and dry. *See* CLIMATE, Treatment of Disease by.

BORMIO, in Italy.—Thermal waters. *See* MINERAL WATERS.

BOTHRIOCEPHALUS (βόθριον, a pit; and κεφαλή, the head).—A genus of cestode entozoa, characterised by the possession of two pits or depressions, one on either side of the head, in place of the four sucking discs usually present in tape-worms. *See* ENTOZOA.

BOTS.—A term employed to designate the larvæ of certain dipterous insects called gadflies. They infest man more rarely than animals. *See* ENTOZOA.

BOULIMIA.—*See* BULIMIA.

BOURBONNE - LES - BAINS, in France. — Common salt waters. *See* MINERAL WATERS.

BOURBOULE, LA, in France.—Thermal alkaline and arsenical waters. *See* MINERAL WATERS.

BOURNEMOUTH, in Hampshire.—Regarded as a suitable winter residence for patients suffering from certain forms of chest-disease. The climate is mild and slightly humid. *See* CLIMATE, Treatment of Disease by.

BOWELS, Diseases of.—*See* INTESTINES, Diseases of.

BRAIDISM. — SYNON.: Hypnotism. — Braidism is the name which, after its inventor, James Braid, has been applied to a therapeutic method destined to utilise the undoubted powers of mind over body for the cure of various diseases. In essence it consists of a species of Mesmerism, the patient being reduced to a partial or complete trance-like condition, by being made to look fixedly for a few seconds at a bright object held by the operator at 'about eight to fifteen inches above the eyes, at such a distance above the forehead as may be necessary to produce the greatest possible strain upon the eyes and eyelids, and enable the patient to maintain a steady fixed stare at the object.' The patient must be made to understand that he is to keep his eyes steadily fixed on this object, and his mind riveted upon the image of it. After so short a time as ten or fifteen seconds some patients may be intensely affected; and if so, it will be found, on gently elevating the arms and legs, that the patient has a disposition to retain them in the situation in which they have been placed. 'If this is not the case,' Mr. Braid writes, 'in a soft tone of voice desire him to retain the limbs in the extended position, and thus the pulse will speedily become greatly accelerated, and his limbs in process of time will become quite rigid and involuntarily fixed.' By slightly prolonging this process a condition of profound 'nervous sleep' may be induced, in which operations may be performed as easily and in as painless a manner as if the patient had been under the influence of chloroform. All this has been abundantly proved by Esdaile and others, who performed numerous operations upon Hindoos, with absence of all pain, whilst they were in the hypnotic state. In his attempts to cure morbid conditions, however, Braid only rarely proceeded so far as to induce actual unconsciousness. Whilst in a semi-cataleptic condition the patient's attention is strongly directed to the morbid part, and some very marvellous instances of relief are recorded by him, said to have been effected under the influence of this faculty only, without the aid of imagination, since some of the patients operated upon were quite incredulous as to any good being likely to result. In a recent work on 'The Influence of the Mind upon the Body,' Dr. Daniel H. Tuke remarks: 'Braidism possesses this great advantage, that while the Imagination, Faith or Expectation of the patient may be beneficially appealed to, this is not essential; the mere concentration of the attention having a remarkable influence, when skilfully directed, in exciting the action of some parts, and lowering that of others. The short period of time required, also, compares favourably with that consumed in some other forms of mental therapeutics. . . . The great principle which appears to be involved in all is the remarkable influence which the mind exerts upon any organ or tissue to which the Attention is directed, to the exclusion of other ideas, the mind gradually passing into a state in which, at the desire of the operator, portions of the nervous system can be exalted in a remarkable degree, and others proportionately depressed; and thus the vascularity, innervation, and function of an organ or tissue can be regulated and modified according to the locality and nature of the disorder.' Braidism is a method very difficult of adoption in ordinary practice, and which, however legitimate may be its foundations, would, unless the greatest care and vigilance were exercised, be apt to descend perilously near to the level of quackery. If, however, only a small part of the results attributed to Braidism would follow the systematic adoption of this method for the alleviation of many diseases, it is one which should commend itself to the earnest attention of inquirers, who may be able to place the practice upon a broader and firmer foundation than that on which it rests. But unfortunately the method has of late fallen somewhat into disrepute. This has been due to two causes. First, because of the facility with which it may be practised by non-medical persons, and the difficulty often experienced, even by medical men, in rousing persons from the state thus induced. And, secondly, because, even when practised by medical men, disagreeable consequences are apt to follow with some patients: fits may be induced, or the patient's moral and emotional control may be for a long time greatly impaired. In consequence of such results, a Government order has been issued in France, forbidding surgeons in the army and navy to have recourse to this method of treatment. Unquestionably, however, the labours of many French physicians have done much of late years to render definite and precise our knowledge of the various phases of hypnotism, of the modes in which they are inter-related, as well as concerning the best means of inducing or terminating this or that particular phasis. A revival of the practice has recently taken place in this country—sometimes in the highly objectionable form of public exhibitions. *See* MESMERISM.[1] H. CHARLTON BASTIAN.

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[1] See also *Mesmerism, Spiritualism, &c., Historically and Scientifically Considered.* By W. B. Carpenter, C.B., M.D., LL.D., F.R.S. 1877.

BRAIN, Diseases of.— General Observations.—The range of unnatural phenomena which manifest themselves as the result of disturbed actions of the brain, whether from functional perturbations or structural disease, is wide and varied. This result is due: (1) to the fact that the brain, though spoken of as a single organ, is really a congeries of many distinct but functionally related parts; (2) to the fact that this congeries of parts is continuous with the spinal cord and intimately related to a scattered network of ganglia—entering into the formation of the nervous system of organic life; and (3) to the fact that these several centres within and without the cranium are brought into connexion, through the intervention of nerves, with all other structures in the body, whether entering into the composition of the organs of relation, or into that of the visceral system.

The action of particular parts of the brain may be stimulated, depressed, or suppressed, and either of such altered modes of activity may entail a stimulation, depression, or suppression in the functions of one, two, or more distant parts of the nervous system. The first class of effects are spoken of as *direct*, and the second as *indirect* symptoms. It is often extremely difficult, if not impossible, for us to say which of the symptoms presented by a patient suffering from organic disease of the brain should be ranged under the one head and which under the other. Our ability to make such distinctions is at present hindered by our still incomplete knowledge concerning the anatomical details of the brain, the proper functions of its several parts, and the precise modes in which they co-operate with each other.

The effects of a shock, whether produced by injury or disease, falling on such an extensive assemblage of sensitive and mutually related organs are, as may be well imagined, subject to much variation; and as a matter of fact it happens that in different cases of cerebral hæmorrhage, the symptoms produced are dependent upon three factors, viz., the *situation*, the *extent*, and the *suddenness* of the lesion. Except in so far as the nature of the lesion tends to entail variations in one or other of the above-mentioned respects, it is not of much significance from a clinical point of view (*i.e.* it does not lead to much difference in the sets of symptoms produced) whether we have to do with a case of hæmorrhage into, or with a case of softening of the brain. Thus the 'locality' and extent of the lesion, in the case of a local disease of the brain, has always to be inquired into as a problem altogether apart from that of the nature of the pathological change in the part affected. In other words, the problem of diagnosis in brain-disease is twofold: it must have reference to the region affected (regional diagnosis) and to the pathological cause (pathological diagnosis). The causes interfering with the progress of our knowledge in the former direction are both numerous and baffling, so that, until the last few years, comparatively little progress had been made.

Symptoms.—The most frequent effects or symptoms of functional or structural brain disease may be thus classified:—

1. Perverted Sensation and Perception.—The special senses of smell, sight, hearing, touch (fifth nerve), or taste may be interfered with by diseases of their respective nerves or primary ganglia within the cranium. Owing to the decussation of the optic nerves, disease of the optic tract gives rise (most frequently) to an affection of the sight of the opposite eye. The sense of taste is subserved by two nerves proceeding to the same nucleus. Thus, the glosso-pharyngeal has to do with this special sensation in the back part of the tongue, the palate, and fauces; whilst the taste-nerves for the front part of the tongue, though they pass from these parts with the lingual branch of the fifth, leave it by the chorda tympani and then proceed to the brain as the nerve of Wrisberg, which terminates in the nucleus of the glosso-pharyngeal. Disease of the intracranial portion of the fifth nerve thus does not affect the sense of taste, though it impairs the common sensibility of the tongue.

Disease of the primary ganglia of these nerves, whether they are separate (first and fifth) or lodged in the brain-substance at its point of connexion with the nerve, will produce decided impairment of the several special senses. But disease of portions of the brain above these regions on one side only, even though very extensive, often exists without seeming to disturb the exercise of the special senses on either side. This, doubtless, depends in part upon the comparatively wide distribution of the several sets of sensory fibres within the hemispheres, and in part upon the liability of unilateral sensory defects to escape observation. There is, however, one limited region in each cerebral hemisphere where the several sensory paths are brought into close relations with one another, before they diverge to different parts of the cerebral cortex. This region is the posterior third of the hinder segment of the internal capsule, and it is now well known that lesions which involve it give rise to a complete *hemianæsthesia* of the opposite side of the body, in which the special senses as well as the common sensibility of the one half of the body are affected. Sometimes this result seems to be due to functional disorders, and at other times it is a consequence of structural disease. Hemianæsthesia varies widely in its degree of completeness, and also in its duration or persistence, and that is the case where it is of functional origin as much as where it is due to actual organic disease.

There may, however, be *illusions*, *hallucinations*, or *delusions*, in connexion with one or other of the special senses, in many functional and structural diseases of the brain, where the morbid condition is situated in parts higher up than the primary ganglia, or where there is a functional exaltation of the ganglia themselves. This latter functional exaltation seems sometimes to be favoured by morbid states of some of the viscera—especially of the stomach, or of the uterus and ovaries.

Still, modern clinical as well as experimental evidence has done something towards revealing the paths and special cortical termini connected with different modes of sensibility. The experimental observations of Ferrier point to the convolutions about the tip of the temporal lobe as the seats of the senses of smell and taste. The same observer locates the cortical terminus of the sense of hearing in the upper temporal convolution. The more recent experiments of Schäfer and Sanger-Brown seem, however, to negative this conclusion, and to leave its site altogether uncertain.

In regard to the visual sense, both experiment and clinical observation now point to the occipital lobe (and more especially to its inner aspect) as the region most concerned with this endowment. But the relation is a peculiar one. Extensive disease of the inner part of the right occipital lobe, for instance, would not give rise to more or less complete blindness of the opposite eye only—it would produce rather a left-sided hemianopsia. Similarly, the right halves of the visual fields are represented in the left occipital lobe, so that destruction of it would give rise to right-sided hemianopsia.

The cortical centre for touch and common sensibility is now, since the experiments of Horsley and Schäfer, believed to be the hippocampal convolution and the gyrus fornicatus, that is the region of the brain named by Broca the 'falciform lobe.' Under the term 'common sensibility' are included different modes of sensibility; thus it comprises, in addition to touch, the appreciation of differences of pressure and of temperature, and of painful impressions. Ferrier and some others would also include the impressions of the 'muscular sense' under this head of 'common sensibility' and would refer them to the same cortical terminus. This, however, is a position which the writer contests. He believes, with Hitzig and others, that Ferrier's so-called 'motor centres' are in reality muscular-sense centres, and that no real motor centres exist in the cerebral cortex (*Brain*, April, 1887). Others again, like Seguin, without questioning Ferrier's general doctrine as to the existence of motor centres in the cerebral cortex, think there is evidence to show that 'muscular sense' impressions are registered in the cortex apart from those of common sensibility, and that their special terminus is to be found in the inferior parietal lobule. This subject, therefore, although very important, is at present in a very unsettled condition. *See* KINÆSTHESIS.

Besides diminutions of sensibility, we often have to do with perversions of sensibility—that is, with disagreeable sensations of numbness, tingling, or actual neuralgic pains in parts. The seat of the two former may be widely distributed, though neuralgia from intracranial disease is principally limited to some part of the territory of the fifth nerve.

2. **Perverted Emotion and Ideation.** These manifestations vary, from the mere increased tendency to emotional displays seen in hysterical persons, or in persons suffering from hemiplegia associated with emotional weakness, to those more complex aberrations met with in the various forms of delirium and insanity. *See* INSANITY.

3. **Perversions of Consciousness.**—Under this head may be included the comparatively rare states known as somnambulism, ecstasy, catalepsy, and lethargy; as well as the common conditions of drowsiness, stupor, and coma. The former may be said in almost all cases to be associated with functional rather than with structural disease of the brain; at least, this is most in accordance with our present knowledge. Drowsiness, stupor, and coma are, however, among the commonest results of organic disease of the brain (*see* CONSCIOUSNESS, Disorders of), though they are also common conditions in blood-poisoning—whether arising from fevers, uræmia, or alcohol, poisonous doses of opium, or other narcotic or narcotico-irritant drugs.

4. **Perversions of Motility.**—These manifest themselves in many forms, which, however distinct they may appear to be, are, nevertheless, closely linked to each other.

Tremors may be general or local, and in the latter case they may be most marked in the tongue and facial muscles—principally those about the corners of the mouth or the orbicularis palpebrarum. General tremors may arise from debility, over-exertion, 'nervousness,' old age; or they may be due to alcoholic or mercurial poisoning, or to degenerative disease about the pons and medulla, and other regions of the brain.

Twitchings may be characteristic of a highly nervous habit of body, and are especially frequent in some epileptics in the interval between their fits, either in some of the facial muscles or in those of the neck or limbs. They may also occur in acute febrile affections, in which the functions of the cerebrum are involved, as shown by coexisting delirium, &c., and also in the course of many organic diseases of the brain. In chorea the irregular movements of different parts of the body are often of this nature;

they may affect both sides of the body, or only one (hemichorea).

Spasms of a continuous or 'tonic' character are encountered in various diseases of the nervous system, such as laryngismus stridulus, trismus, hydrophobia, tetanus, hysteria, and some forms of hemiplegia and paraplegia. Such tonic spasms produce a muscular rigidity which has to be distinguished from that due to chronic changes in joints and tendons, such as are apt to occur in limbs long paralysed.

Clonic Spasms or *Convulsions* may be either unilateral or general, and may be induced by the most varied causes. When well-marked they are mostly attended by loss of consciousness, as in epilepsy and the majority of epileptiform attacks. They are often limited in their distribution, rather than general, whether the convulsions be of unilateral or bilateral type.

Co-ordinated Spasms, or movements of a struggling type, are met with in many epileptiform and hysterical paroxysms. Spasms of this type may be also limited to particular groups of muscles, as in the conjugated deviation of the eyes and neck occurring in hemiplegia, in wry-neck, in writer's cramp, and other allied affections.

Paralysis may be local and limited in seat to some of the ocular muscles, the muscles of mastication, the facial muscles, those of the tongue, or to parts supplied by the spinal accessory and pneumogastric nerves, in those cases in which there is merely an implication of the intracranial portion of one or more of the motor-cranial nerves about the base of the brain. In other cases it may take an incomplete or a complete *hemiplegic* type, when the lesions are limited to one half of the brain, and involve directly or indirectly certain regions thereof. Beginning at the surface, these regions include the so-called 'excito-motor' area, comprising the convolutions bordering the fissure of Rolando and the contiguous inner surface of the hemisphere, from which a fan-like distribution of white fibres converges to what is known as the 'internal capsule,' whence these efferent fibres are continued through the peduncle and pons to the bulb. Lesions at the part of the surface mentioned, or directly or indirectly involving any part of the tract of fibres issuing therefrom, give rise to a more or less complete hemiplegic form of paralysis. Whether these portions of the cortex contain motor centres, or centres which register 'muscular sense' impressions, is a matter of interpretation which is at present involved in doubt. What seems certain is that these are the last portions of the cortex called into activity in the execution of movements, and that from them issue the fibres which convey motor incitations to centres throughout the bulb and spinal cord (*see* KINÆSTHESIS). In other cases, where a large lesion exists in the pons Varolii, or where the functions of both cerebral hemispheres, or their peduncles, are gravely interfered with, the paralysis may be general, involving both sides of the body. In some of these cases, and especially with right-sided paralysis, various difficulties exist in giving expression to thoughts by means of speech or writing (*see* APHASIA). Deficient action of the will (induced by lowered activity in one or other of the cortical sensory centres, though without obvious structural change) may cause a temporary paralysis in hysteria and allied states.

Defective Co-ordination of muscular acts is met with, as in stammering and in some hemiplegic defects of speech; also in the body generally in some cases of cerebellar disease, producing a peculiar and unsteady gait (titubation) closely resembling that which may be met with in alcoholic intoxication. Similar motor disturbances may be induced by vertigo of well-marked degree. Vomiting, again, is a reflex motor act due to impaired co-ordination, which occurs in many forms of brain-disease. More rarely the sphincter ani and the sphincter vesicæ become relaxed, or the bladder may be paralysed. But incontinence of fæces or of urine, or inability to void the urine, is comparatively rarely met with as a result of brain-disease, except in the comatose state, in patients who are more or less demented, or in those in whom lesions exist in both hemispheres of the brain.

5. **Nutritive or Trophic Changes.**—With lesions in the 'motor tract' of the brain, in or below the Rolandic area, a band of degeneration occupies a part of the internal capsule, crus cerebri, pons, and medulla on the same side, and (below the decussation of the pyramids) the opposite lateral column of the spinal cord. This is one of the most important of the trophic changes occasioned by brain-disease, because the degeneration in the lateral column of the cord is apt to spread to the contiguous grey matter, and thus give rise to some secondary trophic changes not infrequently met with in paralysed limbs.

Trophic changes in other organs (occasioned by some severe lesions in the brain) appear as low inflammations and congestions—for example, of the lungs, or as hæmorrhages into these organs; also as hæmorrhages beneath the pleura or endocardium, or even into the substance of the suprarenal capsules or kidneys.

Again, we may have acute sloughing of the integument in the gluteal region on the paralysed side, dropsy of paralysed limbs, inflammations of joints and of the main nerves of paralysed limbs, and, though more rarely, marked atrophy of paralysed muscles. Retardation or arrest of growth is also apt to occur in paralysed limbs, when we have to do with infants or young children suffering from severe organic brain-disease.

Blanching of the hair, or altered pigmentation of the skin, also occurs not infrequently in connexion with brain-disease or violent mental emotions; whilst in the insane the nutrition of bones, and of the pinna of the ear, is apt to be interfered with.

6. **Perverted Visceral Actions.**—Exalted activity of the uterus, bladder, intestine, stomach, or heart may be occasioned by functional brain-disturbance more especially; whilst related brain-conditions may give rise to depressed or exalted activity of the liver or kidneys. With other functionally disturbed or emotional brain-states there may be a lowered functional activity of the salivary glands, of the heart, of the respiratory organs, of the organs of deglutition, of the organs of digestion, or of the sexual organs. These are only to be taken as mere indications of the kinds of modification that may be produced in visceral activity by brain-disease. Much doubtless remains to be learned in this direction.

It seems fitting here also to mention those contractions and dilatations of vessels which are apt to take place in different parts of the surface of the body, or in internal organs, from stimulation or the reverse of vaso-motor nerves, occasioned either by direct or indirect influence exerted upon the principal vaso-motor centres in the region of the medulla. These contractions or dilatations produce correlated alterations in the temperature, sensibility, and functional activity of the parts or organs affected. The temperature of paralysed parts, as well as the general body temperature, is subject to great variations in the apoplectic state, and these are now beginning to be studied more attentively. They are capable of yielding diagnostic indications of great value.

GENERAL REMARKS.—Some general remarks on the subject of structural and functional diseases of the nervous system, showing how intimately these two classes of disease are related to one another, will be found in the article NERVOUS SYSTEM. Most of what is said there is applicable to diseases of the brain in particular; here, however, it is necessary to call attention to certain points specially related to brain-disease.

When paralysis occurs from brain-disease affecting one cerebral hemisphere, in the great majority of cases it is situated on the opposite side of the body, owing to the fact that the fibres conveying the volitional impulses to the muscles decussate in the medulla oblongata. It is true that many cases are on record in which the paralysis either has, or has been said to have been present on the same side as the brain-lesion. A certain number of these cases are probably due to errors either in the clinical or in the post-mortem records of the case. Others, however, may be due to the fact that in the individuals in question the customary decussation, above referred to, did not exist. The characters of the various forms of paralysis due to brain-disease are briefly set forth in the article on PARALYSIS.

Lesions of the left hemisphere, much more frequently than those of the right, are associated with aphasic defects of speech; whilst, according to Brown-Séquard, lesions of the right hemisphere are more frequently and rapidly fatal than otherwise similar lesions of the left hemisphere. They are also said to be more apt to be associated with acute sloughing of the skin on the paralysed side. Convulsions at the onset, and subsequent tonic spasms of the paralysed limbs, are also said by the same authority to be more frequently associated with left- than with right-sided paralysis. These statements, however, stand in need of confirmation.

Congenital atrophy of one hemisphere, or an atrophy or severe lesion occurring in early infancy, is mostly associated with an arrest of growth and development in the limbs on the opposite or paralysed side of the body, or with a more or less spastic condition of the limbs (' birth palsies ').

Very little is positively known concerning the diseases of the cerebellum. Of its functional affections we may be said to know absolutely nothing. That is, of the various functional diseases of the nervous system with whose clinical characters we are familiar, we are unable to name even one which we can positively say is a functional disease of the cerebellum. Whatever the precise mode of activity of the cerebellum may be, there is a general consensus of opinion that it is principally, if not exclusively, concerned with motility, and that it has more especially to do with the higher co-ordination of muscular acts. Atrophy of one hemisphere of the cerebrum is followed by atrophy of the opposite half of the cerebellum, so that there is a strong presumption that the functional relationship of either half of the cerebellum is with muscles on the same side of the body. Clinically we know that disease of the cerebellum is not infrequently associated with more or less marked paralysis on the opposite side of the body; but this effect is now generally attributed to the pressure which structural diseases of the cerebellum are apt to occasion on the pons and medulla of the same side.

ÆTIOLOGY.—The principal modes of causation of diseases of the brain, functional as well as structural, may be thus summarised:—

1. *Defective nutrition* operates by modifying the proper constitution of nerve-tissues as well as the constitution of the blood, and thereby interfering with the normal functional relations of the several parts of the brain. Anæmia, chlorosis, syphilis, ague, and all lowered states of health, howsoever induced, and whether acquired or inherited, become predisposing or actual causes of brain-disease.

To these states, favourable to the manifestation of brain-disease, should be added the various acute specific diseases, uræmia, metallic poisoning, poisoning by the narcotic and narcotico-irritant poisons generally, and also by the occasional qualities of certain articles of food, such as mackerel, mussels, mushrooms, &c.

2. *Emotional shocks* cause cerebral disorder, especially in children; whilst prolonged overwork, particularly when combined with worry and anxiety, with sexual excesses, or with protracted lactation, is apt to induce it in those who are older. Religious excitement, again, in combination with lowered states of health, not infrequently leads to insanity.

3. *Physiological crises*, such as the period of the first dentition, the period of puberty, pregnancy, and the climacteric period, all favour the manifestations of various nervous diseases.

4. *Visceral diseases* or *surface-irritations* (especially in children or in persons having a very sensitive and mobile nervous system) may give rise to varied nervous diseases. Thus we may have convulsions or delirium in children from the presence of worms or other irritants in the intestines; or convulsions in adults during the passage of a renal calculus. Again, we may have the phenomena classed as hysteria, or we may have nymphomania, in consequence of certain states of the sexual organs. Cases of paralysis are said also to have a reflex origin occasionally, though this must be a very rare event. With much greater frequency we find surface-irritations of various kinds leading, as in Dr. Brown-Séquard's guinea-pigs, to epileptiform attacks.

5. *Structural lesions* of the brain itself give rise to a very large proportion of its diseases. The various kinds of change will be found enumerated under another heading (*see* NERVOUS SYSTEM, Diseases of). Hæmorrhage, softening, and tumours are the most common, and, therefore, the most important of these morbid conditions.

6. Brain-disease may be determined by the action of *heat* (*insolatio*), especially when combined with fatigue and deficient aëration of blood. A somewhat similar brain-affection, however, is occasionally developed in the course of rheumatic fever or in that of one of the specific fevers, especially typhoid or typhus, when the temperature of the body rapidly rises to a lethal extent (109°–111° F.).

7. *Concussions* (whether from blows or falls) may give rise to brain-disease, even where no traumatic injuries or lacerations of the brain seem to have been produced.

TREATMENT. — The treatment of brain-disease will be discussed under the articles NERVOUS SYSTEM, Diseases of; PARALYSIS; and CONVULSIONS; and in those on the several special diseases which will now be described in alphabetical order.

H. CHARLTON BASTIAN.

BRAIN, Abscess of. — This term is applicable whenever a circumscribed collection of pus is formed in any part of the cerebral mass.

ÆTIOLOGY AND PATHOLOGY.—Amongst the most frequent causes of cerebral abscess are severe injuries to the skull, disease of the temporal bone in connexion with the ear, ligature or obstruction of a main artery, and pyæmia. Under the three first-named conditions the abscess is usually solitary, but from pyæmia multiple abscesses often result. For practical purposes we may perhaps conveniently discard the latter—since the symptoms will usually be those of general encephalitis—and confine ourselves to those cases in which single, large-sized collections of pus are met with. With this limitation, abscess in the brain is by no means of frequent occurrence.

The best marked, and also the more common examples of large cerebral abscess are met with in connexion with compound fractures of the skull, and by far the most definite symptom which denotes them is the formation of a fungus cerebri. Unless in a compound fracture the brain be directly injured and the dura mater torn, it is very rare indeed for any suppuration in its substance to occur. It is not to be denied, however, that now and then, after severe concussion or laceration without external wound, abscess may follow. In such cases we may conjecture that usually some slight laceration or extravasation occurred in the first instance, which constituted a focus for the inflammation. Abscess after simple concussion without lesion is probably a most rare event.

In the article BRAIN, Inflammation of, we shall have to define Encephalitis as a diffuse change of a large part of the cerebral mass, perhaps of a whole hemisphere, attended by the infiltration of cells and fluid. It is obvious that the term abscess in the brain is applicable to one of the results of encephalitis, but it seems clinically probable that the two classes of cases are for the most part distinct, and that diffuse encephalitis has but little tendency to result in abscess, and that abscess is rarely preceded by a stage of encephalitis. Both are usually the consequences of local injury to the brain, or of extension from local disease of its coverings; but whilst encephalitis probably resembles the erysipelatous type of inflammatory action, in localised abscess this tendency is not present. Having distinguished brain-abscess from encephalitis, we must next say a word as to the risk of confusing it with intra-cranial but extra-cerebral collections of pus. Encysted collections of matter may be met with either between the dura mater and bone, or within the arachnoid cavity; and perhaps it ought to be added, though with some hesitation, beneath the arachnoid, in the pia mater. Not infrequently inflammation of the membranes precedes and attends the formation of an intra-cerebral abscess, and in these cases the symptoms will be mixed. In dealing with published cases it is also necessary to be on our guard as to certain errors which have crept in—cases of meningeal abscess being spoken of as brain-abscess. Sir Prescott Hewett has expressed his opinion that the celebrated case of de la Peyronié's was an example only of extra-cerebral abscess. It is absolutely necessary to make these restrictions, if we would judge correctly as to the symptoms which attend local collections of matter in the brain, and the usual terminations of such cases.

The contents of a cerebral abscess usually consist to some extent of broken-up cerebral tissue, and in some cases there are but very few pus-cells. Especially is this likely to occur when the so-called abscess follows on ligature of the carotid or occlusion of a cerebral artery. In these cases, it is, in the first instance at least, the result of a process of softening rather than of true suppuration.

Symptoms.—The symptoms of local suppuration in the brain will vary with the stage, the size of the collection, its precise situation, and above all, with the presence or otherwise of a fistula of relief. In many of the cases which come under surgical care a fistula exists from a very early period, though not infrequently it is liable to occlusion. Under the latter conditions the symptoms of a closed and an open cerebral abscess may be alternately studied in the same case. It will usually be observed that when the exit is closed, and the abscess fills, the patient complains more or less of headache, becomes heavy and drowsy, and experiences twitchings or spasms in the opposite side of the face and limbs, with some tendency to hemiplegia. Of this group the tendency to spasms is probably by far the most significant. The headache may be but trifling, and the patient may even be well enough to leave his bed, when the occurrence of spasm followed by paresis alono gives warning of what is going on. Temperatures are in such cases very misleading. Persistent elevation is a symptom to be attended to, but its absence is no safe ground for negative conclusions. The cases now alluded to are chiefly those in which abscess results from compound fracture of the skull with laceration of the brain-substance. In these the abscess often gives way spontaneously, and a fistula forms, around the orifice of which a mass of pouting brain-granulations, known as *fungus cerebri*, usually forms. In these cases the canal of communication may be very tortuous, and the liability to blocking considerable. Now and then the same result may be met with after syphilitic disease of the skull and meninges. The writer had some years ago a man under his care in whom he had opened a cerebral abscess beneath a hole in one parietal bone. The patient was able to walk about, and ailed but little so long as the fistula was freely open; but spasms of the face, or even convulsions of the limbs (on the opposite side), always followed its occlusion. The softening gradually extended, and he at length died in consequence, perhaps, of the impossibility of making a counter-opening in a depending situation. Unless the abscess be in the anterior lobe, there will almost invariably be present some degree of hemiplegia, but this will of course vary with the size of the collection and the extent of destruction of tissue. The formation of an abscess after injury is sometimes very insidious, the symptoms being very slight. The cases in which violent headache and pain, vomiting, delirium, and dry tongue, are said to have been present in the early stages are, it may be suspected, usually instances of suppuration between the bone and dura mater. These symptoms occur especially when brain-abscess follows disease of the internal ear, and in these there nearly always is the complication of inflammation around the petrous bone. Such symptoms are very rarely present in traumatic abscesses, which often develop very quietly until they attain a considerable size. It is probable that some degree of rigor, attended with rise of temperature, usually occurs in the beginning of cerebral abscess, but no very precise data are extant on these points.

If a large abscess be permitted to develop without relief, the symptoms of compression will in time ensue: first spasm, then hemiplegia, then hebetude and coma, preceded possibly by violent convulsions. There are cases, however, in which the tendency to increase ceases, and the abscess may pass into a quiescent state and remain for indefinite periods without symptoms.

Diagnosis.—The diagnosis between cerebral abscess and meningeal abscess is exceedingly difficult, and often a guess is all that can be made. The almost invariable occurrence of spasm or convulsions in the former, and their frequent absence with the greater degree of pain and headache in the latter, are the most reliable signs. Sometimes—as, for instance, when trephining has been practised, and no inflammatory products are found between the bone and dura mater or under the latter—the diagnosis may be helped by this negative knowledge. In such cases, if hemiplegia, preceded by spasm, have been gradually developed, the surgeon will be well justified in making an incision or puncture into the hemisphere. Optic neuritis may equally be present in both, and its presence or absence will scarcely help the diagnosis.

Prognosis.—In addition to the danger of death by compression, there is the risk that the abscess may break into the ventricles or into the subarachnoid space. Some cases are on record in which spontaneous openings into the nose or into the ear occurred, and profuse discharge followed, the patient in the end recovering. It may be doubted whether these were not instances of meningeal abscess.

Treatment.—It is needless to say that if abscess be diagnosed with any degree of confidence an opening is essential, and the case must pass into the hands of the surgeon. There is little or no room for medical treatment. Of late years operations with the trephine for the relief of cerebral abscess have been attended with very encouraging success. For the prevention of abscess, in all cases in which injuries likely to produce it have occurred, the utmost precautions should be enforced. Mercury in small doses, frequently repeated, should be given from the first; the injured region should be covered with lint soaked in a strong spirit-of-wine lotion, frequently re-wetted; purgatives should be administered; and the patient should be kept very quiet until long after the healing of the wound.

Jonathan Hutchinson.

BRAIN, Anæmia of.—Definition.—A condition in which the blood contained within the brain, and especially within the capillaries of the brain, is deficient in quantity, or defective in nutritive quality, or both.

The blood within the brain is contained in arteries, capillaries, and veins. The functional condition of the brain depends on the quantity and quality of the blood circulating in its capillaries, and it is to these that the special symptoms are related. Deficiency in the quantity contained in the arteries or veins can scarcely occur without the condition being shared by the capillary circulation. Defect in the quality of the blood supplied to the brain is always of gradual occurrence, and affects the whole brain; deficiency in quantity of blood may affect the whole brain or part only, and it may be sudden or gradual in its production.

Ætiology.—*General cerebral anæmia* may be due to the following causes:—(1) It may be a part of systemic anæmia—defect in quantity or quality of the whole blood, and from causes which are considered elsewhere. This is often seen in cases of hæmorrhage, of exhausting discharges, or of defective blood-nutrition, as in chlorosis. (2) The supply of blood to the brain may be deficient, the quantity of blood in the body being normal. The cerebral anæmia is then part of a cephalic anæmia. In consequence of posture in relation to gravitation the supply of blood to the head is that which is especially interfered with by any diminished movement of the blood. At the same time the closure of the cavity in which the brain is situated, and the unreadiness of the cerebro-spinal fluid to undergo rapid change of distribution, preserve the blood in the head from the extremely rapid diminution to which it would probably otherwise be liable—possibly, indeed, to a degree incompatible with life. Cephalic anæmia may be due to cardiac weakness, or to causes acting through the nervous system on the heart, as in swooning. In systemic anæmia, the lessened cardiac power increases the cerebral deficiency. Whatever lessens the amount of blood discharged from the heart at each systole, such as aortic or mitral disease, may be a cause of cerebral anæmia. Pressure on the vessels conveying the blood to the head, as by an aortic aneurysm, has a similar effect. Unequal distribution of the systemic blood is another cause. The intestinal vessels, if dilated, are capable of containing a large part of the blood of the body, and the effect of their engorgement is often seen after paracentesis abdominis. One theory of shock ascribes its mechanism to vaso-motor dilatation of these vessels, and consequent anæmia of the rest of the system. Severe diarrhœa or dysentery is an occasional cause of symptoms of a very pronounced and prolonged character. (3) The capacity of the cerebral vessels may be diminished by pressure on the brain, exerted by effusions of fluid (hydrocephalus), of blood (in cerebral and meningeal hæmorrhage), or by growths within the skull. (4) General contraction of the arteries of the brain is a rare cause, probably confined to some toxic states, such as that of Bright's disease, in which such contraction can be seen in the retina.

Partial cerebral anæmia is due to local obstruction to the passage of the blood through an artery. To be permanently efficient such obstruction must be situated beyond the circle of Willis. Ligature of one carotid causes immediate symptoms of cerebral anæmia, but permanent symptoms are not frequent. Pressure on, or disease of, one carotid, for the same reason, rarely gives rise to symptoms. Obstruction in certain arteries of the brain may cause local anæmia, sudden or gradual, temporary or permanent, according to its cause. Such obstruction may be due to narrowing of the calibre of the vessel by atheromatous changes in its wall, or by spasm of its muscular coat, or may be due to actual occlusion by embolism or thrombosis. The pressure-effects of an intruding substance within the skull (tumour, or clot) act most intensely in one region of the brain, and may influence it only. Arterial spasm is perhaps an occasional cause of local anæmia. Extensively as it has been invoked as a mechanism to explain symptoms, its occurrence has not yet received any definite proof.

It is obvious that of these causes some act suddenly, others gradually, and the symptoms produced will differ accordingly.

Anatomical Characters.—The principal anatomical character of cerebral anæmia is pallor of the brain, observable chiefly in the paler tint of the cortical substance, and the diminished number of red spots in the white centre. The pallor may be partial or general. The membranes are usually pale, but in some cases of partial anæmia they are hyperæmic. Effusion of serum in the meshes of the pia mater and between the convolutions may be found in general anæmia.

Symptoms.—The symptoms of this condition vary according as the anæmia is suddenly or slowly produced, and as it is general or partial.

(1) In *sudden general* anæmia of the brain the sufferer feels drowsy; the special senses are dulled; noises in the ears and vertigo are complained of; the pupils are at first contracted; sight may fail; muscular power is weakened; respiration is sighing; the skin is pale, cold, and moist; nausea is common; and headache is rare. If the anæmia is more intense, consciousness is lost; there is universal paralysis; and general convulsions may occur, epileptiform in character, these being especially frequent in sudden extensive losses of blood in strong subjects. The pupils dilate, and the coma may deepen to death. The loss of sight may persist, in cases which recover, but retinal changes are then found.

(2) When general anæmia of the brain is *slowly* produced, the state of the cerebral functions is usually that of 'irritable weakness.' Their action is imperfect in degree, and excited with undue facility. There is mental dulness and drowsiness; sometimes, however, insomnia is troublesome. Delirium is common in severe cases, and is conspicuous in some forms of imperfect blood-nutrition, as in the so-called 'inanition delirium.' Headache, usually general, is a common symptom. Sensory hyperæsthesiæ, tinnitus, muscæ volitantes, and vertigo are frequent. Convulsions are rare, but muscular power is generally deficient. All these phenomena are more marked in the erect than in the recumbent posture, especially when the erect posture is suddenly assumed. It has been remarked that some anæmic persons can think well only when lying down. In young children, after exhausting discharges, as diarrhœa, symptoms referable to cerebral anæmia are common, namely, somnolence and pallor, with depressed fontanelle and contracted pupils. The somnolence may deepen to coma with insensitive conjunctiva, and the coma increase to death. Such symptoms have been called *hydrocephaloid*, from some resemblance to those of acute hydrocephalus.

(3) *Partial* cerebral anæmia causes, if complete, loss of function in the affected area; and if it be permanent, as in obstruction of a vessel beyond the circle of Willis, necrosis of the cerebral tissue results (*see* Brain, Softening of). If incomplete and sudden, there is temporary arrest of function. Ligature of one carotid, for instance, causes transient weakness and numbness in the opposite half of the body. There may be at first an over-action of grey matter, causing, in certain regions, unilateral convulsions. The return of the blood-supply, as when a plug shifts its position or is broken up, may not immediately be followed by restoration of function, which may be put in abeyance for some time by the effect of the sudden influence. The loss of memory is occasionally of a remarkable character, involving only the power of retaining new impressions. If slowly developed, as in atheroma of arteries, pain and vertigo are common, with recurring local symptoms, such as numbness, tingling, and weakness.

In all cases of long-continued cerebral anæmia, prolonged damage to the nutrition of the brain may result. In the child the development of the brain may be arrested; in the adult, loss of memory and of general mental power indicate the deterioration of structure. These may last for many months, but commonly pass away at last.

Pathology.—The symptoms are, as already stated, dependent mainly on the defective quantity and quality of the blood circulating in the brain. Some influence may probably be ascribed to the diminution in the blood-pressure to which the nerve-elements are ordinarily exposed (Burrows). Nothnagel has pointed out that the symptoms indicate an early affection of the respiratory centre in the medulla, and of the cortical grey matter. The convulsions in acute anæmia have been ascribed to irritation of the medulla or of the pons Varolii, but our present knowledge suggests that they are due to the altered function of the motor region of the cortex.

Diagnosis.—The diagnosis is not difficult. It rests on the recognition, in a given case, of the cause of cerebral anæmia; and on the exclusion of graver maladies, as organic cerebral disease. With the latter, it should be remembered, anæmia of the brain, local or general, often co-exists. Some symptoms of hyperæmia of the brain closely resemble those of anæmia. A common pathological state of imperfect blood-renewal probably exists in both conditions.

Prognosis.—The extent to which the cause of the anæmia is amenable to treatment, and is of transient character, must influence the prognosis. As a rule this is favourable when there is no organic disease of heart, vessels, or brain. In the so-called 'pernicious anæmia,' the prognosis is, of course, unfavourable. Hydrocephaloid symptoms in infants, if met by prompt and suitable treatment, are usually recovered from.

Treatment.—The treatment necessarily varies in the several forms of the affection, but it is in the main causal. The beneficial effect of the recumbent posture in affording immediate relief to the symptoms, and obviating permanent damage to the cerebral nutrition, must be always remembered. In acute anæmia from loss of blood, the head must be kept continuously low, stimulants freely administered, and as a penultimate resort bandages applied to the limbs from below upwards may increase the proportionate supply of blood to the brain. If this fails transfusion must be had recourse to. In chronic anæmia sudden change of posture should be carefully avoided, and ferruginous tonics are needed. More important than any other element is physical rest, permitting more of the scanty amount of oxygen that can be conveyed by the blood to be used for the nutrition of the protoplasm, *i.e.* tissues on which the vital functions depend. In spasm of the cerebral vessels nitrite of amyl or nitroglycerine should be employed; and a course of the latter, in a small dose two or three times a day, lessens any liability to irregular contraction that may exist. In the cerebral anæmia of syncope, the recumbent posture, stimulants to the skin, cold water, faradisation, sinapisms, and ammonia to the nasal mucous membrane, assist the recovery of cardiac action and the return of consciousness. In all cases, carefully regulated food and stimulants are needed; beef-tea should be given in small quantities at frequent intervals. The group of symptoms called hydrocephaloid requires similar treatment.

W. R. Gowers.

BRAIN, Aneurysm of.—*See* Brain, Vessels of, Diseases of.

BRAIN, Atrophy of.—Atrophy of the brain may be congenital, due to arrest of development in very early fœtal life; or the constituents of the brain may have been perfectly developed, and may subsequently disappear from one of several causes. This morbid state is regarded as *primary* when there has been no pre-existing disease of the brain or its membranes; *secondary*, either when there has been such pre-existing disease, and the atrophy has occurred from absorption of the part broken down by inflammation, softening, hæmorrhage, &c., when atrophy of some special cerebral organ follows upon destruction of the particular nerve that arises from it; or when localised atrophy has taken place in a very gradual manner from pressure of a tumour; of ventricular effusion, &c. To take these forms in order:—

1. *Congenital Atrophy.*—This is usually associated with weakness of intellect, even to the extent of idiocy. There is atrophy of the body opposite to the side of the cerebral lesion, and this atrophy involves all structures, even the bones. Paralyses of various intensity supervene, often with contraction of the paralysed parts; there being no particular sensitiveness of the special senses, possibly because of the mental hebetude. Epileptic attacks are common; vitality is low; and the patient easily succumbs to other diseases.

2. *Primary atrophy.*—In this variety there is general diminution both of volume and of weight, affecting most usually the cerebral hemispheres, and that in pretty equal degree. It is most common as a condition of old age —*senile marasmus*, *atrophia cerebri senilis.* It sometimes in earlier life follows exhausting diseases; and may also be caused by deficient or impure blood-supply to the brain. In close connexion with this mode of causation it is seen after repeated attacks of intoxication, especially after delirium tremens. In this last condition the cerebral atrophy may be acute and rapid.

3. *Secondary atrophy.* — This may be *general* or *partial.* When *general*, the convolutions have a shrunken appearance, and there is always an increase of the subarachnoid fluid. This condition follows various lesions of the brain, especially of the convex surface, such as hæmorrhage of the convexity, encephalitis, or more accurately that form of encephalitis which attacks only the grey matter, or perhaps only one layer of the grey matter, as in some mental diseases. When the atrophy is *partial*, there are found depressions in an otherwise normal hemisphere, at which point a localised hæmorrhage or patch of softening, inflammatory or depending on thrombosis or embolism of vessels, has been absorbed, leaving only a cavity of greater or less extent, filled with fluid and sometimes lined with a thin membrane. A certain portion also of the brain may become atrophied by the gradual pressure of a tumour or any foreign body. Even the little sieve-like depressions seen in various situations after constantly repeated congestion of vessels may be the result of atrophy from compression by the distended vessels. Functional inactivity and atrophy of the optic nerves have led to a similar abnormality of the corpora quadrigemina, and of the higher centres of the perception of vision.

Anatomical Characters.—The atrophied brain, or portion of brain, will vary in appearance on minute examination, according as the lesion has, or has not, been preceded by inflammation. When the atrophy is primary and due to gradual interference with the blood-supply, there is seen a shrunken condition of the nerve-tissue, especially of the calibre of the nerve-tubes. The cells are smaller than usual and pigmented; the arteries are decreased in size or themselves diseased. If the lesion has had an inflammatory origin, the process in order of sequence is, first, inflammation, then softening with fatty degeneration, then partial absorption, and so atrophy; the appearances differing according to the stage of the lesion. Traces of fatty degeneration of all the tissues — vessels, nerve-tubes, and cells — may be found, with the neuroglia either wanting or sclerosed.

Dr. Rudolph Arndt has lately thrown doubt on the possibility of determining atrophy of the ganglionic bodies or nerve-tubes by their size. The size of these bodies varies so greatly, within the limits of health, that he considers this test a very uncertain one. Almost the only trustworthy sign of atrophy, in his opinion, is the appearance in the substance of the ganglionic bodies and in the medullary sheath of nerve-bundles, of black shining globules, somewhat fatty-looking. In process of time these globules increase in number, and at last the whole of the bodies appear permeated by them. These globules are not fatty: they are certainly more or less pigmental. Exactly similar bodies are found in post-mortem examinations, and are a sign of simple decomposition. The duration of this condition, irrespective of pre-existing lesions, is protracted.

Symptoms.—The symptoms of atrophy of the brain necessarily vary according to the seat, extent, and ætiology of the lesion. Primary atrophy of the cerebral hemispheres and the first form of secondary atrophy will most usually induce imbecility, or some lesser degree of mental insufficiency, loss of memory, slowness of thought, and other mental diseases. Headache, giddiness, delirium, and stupor are seldom met with. Interference with speech is more common. Affections of sight, and of the motor condition of the eye, do not depend on general atrophy of the brain; they own a more local cause.

Convulsions, paralysis, stiffness of muscles, or contractions are often met with in connexion with this general lesion, as well as various irregularities of locomotion; but it must be remembered that general atrophy of the brain is not seldom associated with atrophic or sclerotic lesions of the spinal cord, and, even where this is not so, several of the morbid phenomena, and particularly convulsions and paralysis, may derive their origin, not from the atrophy, but from the condition pre-existent to the atrophy, such as hæmorrhage of the convexity, meningitis, or periencephalitis.

In secondary atrophy of a more limited extent, the symptoms are apt to be more strictly localised, such as partial loss of power in a single limb, slight imperfections of speech, or strabismus; but here again the positive diagnosis of atrophy is hindered by the complication of pre-existent disease, the local congestions, hæmorrhages, softenings, tumours, or other conditions of which the atrophy is only the sequence. Still less characteristic are the phenomena attending general or partial atrophy of the cerebellum, the pons, and the medulla oblongata.

Treatment.—Treatment is useless as to the atrophy of the brain: it must be directed to supporting the powers of the patient.

E. Long Fox.

BRAIN, Carcinoma of. *See* Brain, Tumours of.

BRAIN, Compression of.—The brain is compressed in the pathological sense whenever its structure is so squeezed that its functions are in any degree interfered with. This squeezing may be effected either by the effusion of blood within the skull, the growth of a tumour, the accumulation of pus or serum, or lastly by the depression of some large portion of the bony parietes. The general belief that depressed fractures are frequently the cause of compression is probably quite a mistake. In such cases the fragment displaced is rarely of sufficient size to cause serious compression of the contents of the skull, and the symptoms usually supposed to indicate that state are really due in most cases to laceration and contusion, or to subsequent inflammation. This point is of great importance in practice, for upon its recognition depends much of the validity of the reasoning by which the operation of primary trephining in compound fractures is defended or condemned. It also offers a most serious fallacy as regards the interpretation of the symptoms due to compression.

By far the best examples of uncomplicated compression of brain are supplied to us by the not very infrequent cases in which a middle meningeal artery is injured, and a large blood-clot is effused between the dura mater and bone. It is from observation of cases of this kind that the assertion is justified, that a very considerable intrusion into the skull may be permitted without the production of any symptoms. No doubt the suddenness or otherwise has much to do with the results, but there seems good reason to believe that, as a rule, the brain will easily accommodate itself to quantities not exceeding an ounce or two, and that usually as large a quantity as four or five ounces is required to cause death. It is very rarely indeed that a depression of bone in the least approaches such an extent of intrusion as this, and the majority of such cases are, as regards the amount of possible squeezing, quite trivial. The manner in which the accommodation is effected is by the removal of the fluid contents of the skull—first the subarachnoid fluid, and secondly the blood. Of the blood-vessels the veins and venous sinuses are probably emptied first, and lastly the arteries and capillaries. A brain in a state of strong compression is an exsanguined brain. In this respect, the brain in the last stage of compression differs very much from that in cases of insensibility from concussion or contusion. It by no means follows that because the brain is pale, the face should be pale also; but it is perhaps usually the case that extreme compression so much enfeebles the heart's action that the pulse is weak or flickering, the respiration shallow and irregular, and the skin pale and cold. That stertorous breathing, a laboured pulse, and a suffused and dusky countenance are (as according to the classical description) symptoms of compression, is probably for the majority of cases a mistake. Such a group much more frequently denotes laceration, contusion, or central extravasation. Nor is it true that hemiplegia, excepting of the most transitory kind, is often due to compression. A clot of blood poured out over one hemisphere may, if rapidly effused, produce for a while weakness of the opposite limbs, but the brain-mass is soft enough to allow of considerable yielding, and in the course of a few hours the effects of the displacement will have become general, and not local. In a case recorded by the writer in which a post-mortem examination, some weeks later, proved the presence of a large blood-clot, there had been partial hemiplegia without unconsciousness at first, but on the next day all trace of it had disappeared, and it never returned. In many of the cases of bleeding between the dura mater and bone, from the meningeal artery, the hæmorrhage takes place on several different occasions, with, it may be, intervals of a day or two, much as is often observed in wounds of arteries, such as the palmar arch. Thus the observer is able to appreciate the symptoms caused by different degrees of compression, and further proof is afforded that, if the intruded quantity be but moderate, the brain bears it without obvious inconvenience. Often at the autopsy it is quite easy to distinguish clots of very different dates, and to feel sure that the original one was of considerable size. It is clear then that in speaking of the symptoms of compression we must allow for differences in amount of the compressing substance, and also for differences in the rapidity or suddenness of its application.

When compression is produced suddenly, as by a large fragment of bone driven down, the case is almost invariably complicated by contusion. If paralysis or even insensibility be present, it is usually impossible to say to which lesion they are really due. We may, however, hold it almost certain, from what we know of other cases, that the effects in such would be a temporary hemiplegia, with symptoms of shock, if the depression were but moderate; and insensibility, probably soon followed by death, if the depression were very great. The cases in which depression of bone has alone been sufficient to produce long-continued compression with insensibility are possibly somewhat apocryphal. It is possible that compression under such circumstances might be attended by stertor and laboured pulse, but it is possible also that the pulse might be extremely feeble, the countenance pale, and inspiratory efforts weak and irregular.

The depression of bone is perhaps the only condition which can be supposed capable of producing compression suddenly. When blood is poured out from a ruptured artery, the symptoms come on rather gradually. The patient complains perhaps of headache, and then becomes more or less confused in manner, his gait is unsteady, and the limbs on the side opposite to the injury show special weakness. Vomiting may occur and the weakened limbs may twitch, and unless, as is often the case, the intracranial bleeding stops, these symptoms are soon lost in a state of complete insensibility, with pale face, feeble pulse, and symptoms of shock. Convulsions may now occur, and death often supervenes very quickly. In such a case the whole course of the symptoms may occupy less than an hour. The surgeon ought, of course, to trephine and let out the blood, and he must be prompt, or his patient may die during his preparations. More commonly this rapid termination occurs unexpectedly after one or more previous attacks of temporary head-symptoms, and the patient may have appeared quite well in the intervals. In cases in which the symptoms progress without interruption, their rapidity, no doubt, depends upon the size of the vessel ruptured. Certain special symptoms will also depend upon the precise position taken up by the clot which may chance to press upon special nerve-trunks as well as upon the brain-mass. In ordinary cases the clot is beneath the squamous bone and the lower part of the parietal, and passes downwards into the sphenoidal fossa. In the latter region it may press upon the nerves going to the sphenoidal fissure; and it is of importance for the surgeon to know that dilatation of the pupil on the affected side is often produced. This important symptom is probably due to pressure upon the third nerve.

There is yet another class of compression-cases in which that condition is produced by the slow accumulation of the products of inflammation within the skull. Much will depend, as regards special symptoms, upon the position of the abscess, either within or without the brain. If in the substance of the brain, it must more or less disorganise its structure, and thus cause symptoms due to laceration as well as compression. Under such conditions some degree of hemiplegia, with, probably, preceding spasms of limbs, can scarcely fail to be present. Now and then cases occur in which an irregular sinus leads into an abscess-cavity in the brain, and this sinus being sometimes free and sometimes blocked, the surgeon has repeated opportunity of estimating the effects of filling of the cavity. In such cases, headache, stupor, unilateral twitching of limbs, partial hemiplegia, with perhaps vomiting, and, it may be, general convulsions, are the symptoms to be expected. The position of the abscess as regards different regions of the brain is also of much importance, but its discussion cannot be entered upon in any detail here, and it obviously concerns rather disorganisation of structure than simple compression.

When a large accumulation of pus takes place between the bone and dura mater, the symptoms produced are much the same as those caused by blood-clot. We must make, however, much allowance for the fact that these cases are almost always attended by meningitis, and thus the symptoms of compression are masked by those due to inflammation. Chronic abscess under the bone without arachnitis may occur now and then in syphilitic and other disease of the cranial bones, but such cases are very rare. They will differ from those of hæmorrhage in that the symptoms are always produced very slowly. The writer once had the opportunity of watching such a case, in which the patient died of compression, very gradually produced by an increasing collection of pus between the bone and dura mater, and without any complication. The chief symptom was constant wearing headache, which prevented sleep. The man was pale and feeble, but not paralysed in any part, excepting that both eyelids drooped. He was rational, but spoke slowly, as if in a state of partial stupor. During the last two or three days of life he had convulsions; and finally, for twenty-four hours, he was in a state of increasing insensibility.

Diagnosis.—It will be seen from what has been said above that the diagnosis of compression by symptoms is exceedingly difficult, and that the utmost use must in each case be made of the history of the case. In those of blood-compression after injury to a meningeal artery, there is almost always the fact that the patient between the date of the injury and the supervention of symptoms had an interval during which there appeared to be little or nothing the matter. This history is, if the symptoms have developed rapidly and without the signs of inflammation, by itself conclusive for diagnosis. Under such conditions trephining ought to be at once resorted to, or possibly it might be yet better practice to first tie the carotid artery.

The diagnosis of abscess in the brain-substance has already been discussed, and that of inflammatory collections from meningitis will be examined in its proper place. *See* Meninges, Cerebral, Inflammation of, Simple Traumatic.

Treatment.—The treatment of compression of the brain is almost wholly surgical, and consists in the use of the trephine and knife to elevate depressed bone, or evacuate collections of blood or pus. Jonathan Hutchinson.

BRAIN, Concussion of.

—We class under the head 'Concussion of Brain' all symptoms which result simply from the shaking, more or less violently, of the contents of the skull. It will be obvious, however, that most cases of severe shake of the brain are likely to be complicated by visible lesions. The skull may be broken and the brain may be contused, lacerated, or ecchymosed. It is highly probable, however, that well-marked and even serious symptoms may be produced by shaking only, and without the existence of any lesion discoverable either by the unaided eye or the microscope. We must further clearly understand that this element of concussion (*i.e.* the results of shake independent of lesion) enters into almost every case of injury to the head. Whatever be the other lesions, it is usually the fact that the brain has been more or less severely shaken. Thus it may easily happen in cases in which conspicuous lesions are present, such as fracture of the base or local contusion, that still the results of the shake are the most important. It might be convenient if we were in the habit of speaking of most cases of severe injury to the head as *Concussion plus other lesions*, with the endeavour to assign to each added complication its proper share in the general result. These explanations are necessary before we put the question—Can concussion alone cause death? Although it is highly probable that we ought to reply with a very confident affirmation, and to assert that it is not uncommon for concussion to be the chief cause of the fatal event, yet it is very difficult to prove it, since the cases are extremely rare in which severe concussion is produced without some attending lesion. The symptoms caused by concussion of the brain may be studied in very numerous cases of very various degrees of severity, which yet recover perfectly. From what is observed in these, we may infer as to the part which concussion takes in complicated cases many of which prove fatal.

The results of concussion may be divided into three stages. The first stage is that of *collapse*; the second, that of *reaction*, or of vaso-motor paresis, or, if named from its most prominent symptom, the *sleepy* stage; the third is that of *convalescence*, or recovery. The symptoms of the first stage, or stage of collapse, vary with the severity of the case; but if at all well-marked, consist in feebleness of pulse, pallor of skin, coldness of extremities, and dilatation of pupils. They may approach a condition which threatens immediate death. There is no stertor, for the respiration is too feebly performed. Although the collapse may be very great, the insensibility is rarely quite complete. It is of great importance, in this stage, to establish the negative as regards all forms of paralysis. If any non-symmetrical symptoms are present, the case is more than mere concussion. During this stage nothing should be done, except placing the patient in a condition of comfort, and preventing the cooling of the body. Stimulants, unless the collapse is extreme, should be avoided.

After the collapse has lasted some little time (half-an-hour to two, three, or more hours), it begins to pass off. The patient moans, manifests discomfort, turns on his side, and draws his knees up. Very often at this period sickness occurs, and it is almost invariable if the patient's stomach was full at the time of the accident. Consciousness is now usually restored, and, by rousing, the patient may be induced to speak, and will tell his name, &c. Gradually, during a period of some hours, the case slides on into the sleepy stage. The pulse is now relaxed and full, the skin is warm or even hot, the face may be somewhat flushed, and the pupils are contracted. The patient is overpowered with sleepiness, and can only be awakened with difficulty. It is, however, always within possibility to awaken him, and he usually rouses himself to the calls of nature. Very commonly the pulse is irregular, especially if the patient be young. At this stage again care must be taken to ascertain whether there are any non-symmetrical symptoms—any weakness of a limb, of one side of the face, or of any single eye-muscle. If the patient passes his urine or fæces in bed, or if there is long-continued retention of urine, it is very probable that there is more than mere concussion—namely, laceration or contusion. The sleepy stage may last for a day or for a week, and it is in severe cases so well-marked that the patient's eyelids may be held open, and the pupils examined, without awaking him. During this stage the measures of treatment called for are spare diet, purgation, cold to the head, and quiet.

When the sleepy stage passes off, the patient is left weary, torpid, unfit for mental effort, and often with distressing headache. These are the symptoms of the convalescing stage, and they may last more or less for a considerable time. The patient should still be kept carefully quiet, no stimulants should be allowed, and purgatives should occasionally be used. Some of the symptoms present during the stage of convalescence may persist so long that they may rank rather as sequelæ. Thus there may be for years nervousness, inaptitude for business, liability to headache, and peculiar susceptibility to the influence of stimulants. As a rule, however, even after very severe concussion, no such ill-results are left, but the patient regains, after a time, perfect cerebral health. This remark must, however, not be held to apply to concussion when received in railway accidents; for in these cases there is a prospect of pecuniary compensation, and the sequelæ are often severe, prolonged, and very peculiar.

Jonathan Hutchinson.

BRAIN, Congestion of.—*See* Brain, Hyperæmia of.

BRAIN, Hæmorrhage into.—Synon.: Cerebral Apoplexy; Fr. *Hémorrhage cérébrale interstitielle*; Ger. *Hirnschlag*.

Definition.—Escape of blood, by rupture of a vessel, into the substance or cavities of the brain. Hæmorrhage into the meninges is separately described.

Cerebral hæmorrhage is commonly due to the rupture of an artery, very rarely to the rupture of a vein. Occasionally, minute extravasations are caused by rupture of capillaries, and may constitute, by their number, an infiltration of the cerebral tissue with blood. This is seen in cases of venous thrombosis. Hæmorrhage from arteries or veins may also be due to their laceration by injury.

Ætiology. — Arterial hæmorrhage is usually due to the coincidence of weakened vascular wall and increased pressure within the vessel. The causes of these states may be regarded as the conditions *predisposing* to cerebral hæmorrhage. Hereditary influence is sometimes distinctly seen, as a tendency to vascular degeneration, or to conditions which, as renal disease, produce such degeneration. Similarity of vascular distribution may also be inherited, and may determine the locality of strain, and, therefore, first of degeneration, and ultimately of rupture. Cerebral hæmorrhage is most frequent after fifty years of age, but occurs at any age, though rare during the first half of life. It is nearly twice as common in men as in women. It is said to be more frequent in temperate than in tropical climates, in winter than in summer, and at high than at low elevations. Certain acquired conditions act as predisposing causes. Chronic Bright's disease leads to early and extreme degeneration of vessels, as well as directly to hypertrophy of the heart and increased blood-pressure; hence it predisposes powerfully to cerebral hæmorrhage. In purpura and scurvy, cerebral hæmorrhage occasionally occurs, and also in pernicious anæmia and leukæmia. In the latter it is a not uncommon cause of death. In these blood-states the mechanism is doubtless impaired nutrition of the walls of the smaller vessels, which permits them to be bulged and thinned by a blood-pressure that may even be below the normal. The state of vascular repletion known as 'plethora' was formerly thought to be a frequent cause of cerebral hæmorrhage. It probably does aid other causes, but rarely co-exists with the more efficient, and so takes a subordinate position. Chronic alcoholism and opium-eating are said to promote vascular degeneration.

Among other remote causes must be reckoned heart-disease and syphilis, both of which commonly act by causing an aneurysm larger than those that are the special mechanism of hæmorrhage. Nevertheless, such aneurysms often escape even the most careful search. Each of these causes, so different in nature, acts by altering the wall of the vessel—the one by a process of growth, the other by inflammation excited by imperfect obstruction with a plug from an inflamed cardiac valve.

The *proximate* causes of cerebral hæmorrhage are the weakened state of the wall of the vessel, and commonly some increase of blood-pressure. The vessel-wall is weakened by degeneration, and is often imperfectly supported in an atrophied brain. The increase of pressure within the vessels may be permanent, as in peripheral obstruction, with or without hypertrophy of the heart; or temporary, as in excited action of the heart, or impeded circulation through the lungs during effort. These causes are considered more fully in the article on BRAIN, Vessels of, Diseases of.

Hæmorrhage from a vein is rare, except as the result of laceration by direct injury, or of ulceration invading the vein from without. Varicose veins in the pia mater may sometimes rupture (Andral).

Considerable capillary hæmorrhage is usually due to the venous obstruction already mentioned. It may also result from cephalic congestion due to any cause, from capillary embolism, and from the blood-states which cause larger vessels to give way. In all these blood-states similar extravasations are often seen in the retina from the same immediate cause.

ANATOMICAL CHARACTERS.—In intra-cerebral hæmorrhage, the blood is extravasated into the substance or into the ventricles of the brain—into the ventricles usually by rupture of a previous extravasation within the cerebral substance. In the latter situation the blood occupies a cavity formed by laceration of the brain-tissue; rarely, when very minute and 'capillary,' by merely separating the fibres. In size, an extravasation varies from that of a pea or even smaller, up to that of the fist. The blood is found clotted, and reddish-black in colour; fragments of brain-tissue are mingled with it. The cavity containing it is often very irregular in shape; its walls are uneven, present projecting shreds of lacerated brain-substance, and are blood-stained and softened—at first by imbibition of serum, and later by inflammation. Many small extravasations are often seen in the neighbourhood of a larger clot. Usually there is only one large extravasation; sometimes, however, there are two or three. The extravasated blood exercises pressure: the convolutions are flattened; the falx is bulged to the opposite side (Hughlings Jackson, Hutchinson); and the rest of the hemisphere is anæmic. The effused blood may tear its way into the lateral ventricle; it then speedily distends both lateral ventricles and the third and fourth ventricles, and escapes by the openings at the lower extremity of the fourth ventricle, central and lateral, into the subarachnoid space. Or the blood may escape to the surface, infiltrate the pia mater, and tear its way into the subarachnoid cavity, often by a very small opening. It is rarely that the artery from which the blood has escaped can be detected. Occasionally the extravasation can be traced to the rupture of an aneurysm of some size. In other cases miliary aneurysms may be found on many vessels. The larger arteries commonly present atheromatous changes, but these are only associated by being the result of some of the causes, and especially of age.

After a time the extravasated blood undergoes changes. The clot shrinks and gradually becomes, first chocolate, then brown, and ultimately a reddish-yellow; and it then contains chiefly fat-globules, pigment and other granules, and hæmatoidin crystals. The rapidity with which it undergoes this change is doubtful, and certainly varies. It is said that the distinctive blood-colour has disappeared as early as the twentieth day. Meanwhile the walls of the cavity undergo changes. The inflammation, in rare cases excessive and purulent, is usually conservative, and leads to the formation of connective tissue. A firm wall is thus developed, the inner surface of which becomes smooth by the softening and removal of the loose fragments of brain-substance; by this means a cyst is formed. It is said that connective tissue may extend across its cavity, and that in rare cases, the fluid being absorbed, the cyst-walls may unite, and a cicatrix result. Such cicatrices are, however, much more frequently due to softening than to hæmorrhage.

Hæmorrhage may occur in any part of the brain, but is more frequent in some situations than in others. The most frequent seat is the corpus striatum and the region just outside it: nearly half the intra-cerebral hæmorrhages are in this situation. Other primary seats, in the order of frequency, are the centrum ovale, the cortex, the pons and peduncles, the cerebellum, the optic thalamus (often affected by an extension of the hæmorrhage from the corpus striatum), the posterior portion and the anterior portion of the hemisphere. The frequency of hæmorrhage in the cerebrum is twenty times greater than into the cerebellum. The frequent extravasation into and outside the corpus striatum, is explained by the vascular supply. As the rupture is often near the edge of the lenticular nucleus the blood tears up the white substance; and this makes the frequency of hæmorrhage into the centrum ovale difficult to ascertain. *See* BRAIN, Vessels of, Diseases of.

Traumatic hæmorrhage occurs into and from a lacerated portion of brain, and is most frequently found on the surface, occupying mainly the middle of the convex portion of each convolution, and some other regions much exposed to injury, as the surface of the temporo-sphenoidal lobe, and the under surface of the frontal lobe. Ventricular hæmorrhage sometimes results from traumatic rupture of a small vein on the surface of the corpus striatum (Prescott Hewett).

Soft tumours (especially gliomata) are sometimes the seat of hæmorrhage. The distinction from simple hæmorrhage (sometimes difficult) rests on their position being commonly one in which cerebral hæmorrhage is rare; and on some gelatinous-looking tumour-substance being found, into which hæmorrhage has not occurred, and which has characteristic microscopic features.

Other organs may be healthy, or present the changes which have been mentioned as predisposing causes; the lungs are usually secondarily congested, often intensely.

Symptoms.—The occurrence of cerebral hæmorrhage is indicated by cerebral symptoms of two classes, the one general and more or less transient, the other local and more or less permanent. In addition to these there are sometimes premonitory symptoms; and commonly general symptoms, manifested by pulse, temperature, &c., which are secondary to the brain-lesion.

Premonitory symptoms, somewhat rare, are those of altered cerebral function due to local vascular disease, headache, vertiginous feelings, local weakness or numbness, slight mental changes, and slight affection of speech (*see* Brain, Vessels of, Diseases of; and Brain, Anæmia of). But the disease causing them is commonly distinct from that causing the hæmorrhage. The miliary aneurysms cause no symptoms, and hence it is only in the case of aneurysm of larger vessels that there are true premonitory symptoms. Hence they are less frequent than in cases of softening.

The *onset* of hæmorrhage is usually accompanied with apoplexy, *i.e.* loss of consciousness and of power of motion and of sensation, often with relaxation of the sphincters and loss of reflex action (*see* Apoplexy, Cerebral). These symptoms are profound and lasting according to the size of the hæmorrhage and its position; being especially marked in large and double effusions, in intra-ventricular hæmorrhage, and in hæmorrhage into the pons. In a case of moderate severity they last only a few hours, and gradually pass away. In severer cases they may deepen until death occurs from failure of respiratory power. Death is rarely very speedy, life being usually prolonged for some hours even in the most rapidly fatal cases. In rare instances of hæmorrhage into the medulla, and also in meningeal hæmorrhage, death has occurred in five minutes, probably in each case from the rapid interference with the respiratory centre.

The temperature is at first lowered one or two degrees; the pulse becomes less frequent; and the respiration slow. The Cheyne-Stokes respiratory rhythm often precedes death. After a few hours the temperature rises to the normal and in mild cases stops there, but in graver cases it rises above the normal two or three degrees. In some very grave cases the initial fall or subsequent rise may be extreme and go on until death occurs, sometimes reaching 90° in the one case, and 107° or 108° in the other (Bourneville). The urine is at first abundant, of low specific gravity, and acid in reaction.

In slight cases of cerebral hæmorrhage there may be no loss of consciousness. Vomiting in such cases is not infrequent. In other rare cases of large hæmorrhage, especially between the external capsule of the corpus striatum and the island of Reil (Broadbent), the loss of consciousness comes on gradually, after other symptoms, as of shock, for example, have lasted for an hour or two. These cases have been termed *ingravescent*.

Local symptoms, often permanent, and always of longer duration than the loss of consciousness, are present in all cases of circumscribed cerebral hæmorrhage, except in the rare instances in which, by its central position in the pons and medulla, it causes directly bilateral effects only, which are added to and intensify the general symptoms caused indirectly. In a unilateral cerebral lesion, the direct symptoms are unilateral loss of power of voluntary movement and often of sensation, accompanied sometimes with convulsion or rigidity. These local symptoms may commence a few minutes or longer before the loss of consciousness. They coexist with the apoplectic condition, and may often be recognised, even during coma, by the flaccidity of the paralysed limbs, which fall more helplessly than those of the opposite side; by inequality of the mouth and of the pupils; by conjugate deviation of the head and eyes towards the side of the brain injured; by convulsive movements; and, as the apoplexy clears, by the detection of unilateral defect of sensibility. The coma passing away, these signs become more distinct, and all the symptoms of hemiplegia remain, varying in intensity and extent according to the position of the lesion. The apoplectic state may recur after its disappearance—a grave symptom, usually indicating that a fresh hæmorrhage has occurred in the same or the other side of the brain, or more frequently that the blood has escaped into the ventricles. In the former case the unilateral symptoms, conjugate deviation of the head and eyes, &c., are increased on the same, or transferred to the opposite side; in the latter the unilateral symptoms disappear, and general powerlessness and deep coma supervene, with stertor, relaxation of the sphincters, lowered temperature, and impeded respiration. Death always ensues.

Convulsion may be a conspicuous symptom at the onset or subsequently. It is usually unilateral in its course or commencement, beginning on the side paralysed, rarely affecting only the non-paralysed side. In cases in which the blood escapes slowly, convulsions may occur on one side, and in the course of an hour or two may cease, the side at the same time becoming powerless. This is due to the motor structures, commonly those of the cortex, being at first irritated by the hæmorrhage, and afterwards interrupted or compressed so as to be incapable of function. Where convulsion is not met with, muscular twitching or rigidity may occur. General or widely-spread rigidity or twitching points to a bilateral lesion; if with coma, to ventricular hæmorrhage.

After a day or two symptoms of irritation about the cerebral lesion come on, such as headache, delirium, and rigidity in the paralysed limbs. During this period the temperature rises above the normal, and the pulse becomes quick. On their subsidence these symptoms, if the lesion is slight, may be scarcely recognisable, and a stationary period ensues, at the end of which recovery of power over the paralysed limbs begins. In slight cases power may be recovered very speedily. Its return depends upon the structural recovery of slightly damaged tissue, and on other parts taking on an increased function in compensation for that which is destroyed. The electric irritability of the muscles exhibits little change. Sometimes, however, when there is great irritation at the lesion propagated downwards to the cord, a marked initial increase in the irritability may precede a considerable depression, coincident with rapid wasting. Recovery of power is rarely complete except in those cases in which the area of damage is very small; and when the damage is large and affects an important motor region, there may be no recovery, loss of power persisting, commonly with more or less 'late rigidity' in the paralysed limbs. Slight permanent mental change often remains, and as the motor power is recovered, ataxic and other disorders of movement may supervene in the limbs which were paralysed, although much less commonly than after softening.

Diagnosis.—The diagnosis of cerebral hæmorrhage rests on the symptoms of a localised cerebral lesion occurring suddenly. The conditions from which it has most commonly to be distinguished are—congestion of the brain; softening of the brain, embolic and thrombic; and sometimes tumour. For the distinction from it of other causes of apoplectic loss of consciousness, uræmia, post-epileptic coma, &c. *see* Apoplexy, Cerebral.

From *congestion* the chief distinction of the cerebral hæmorrhage lies in the transient nature of the loss of consciousness, and in the slightness and general character of the symptoms which characterise the former. Congestion generally, hæmorrhage only sometimes, comes on during effort; and the absence of history of effort is in favour of the latter. Similarly, the premonitory symptoms which are usually present in congestion are generally absent in hæmorrhage. The loss of motor power, and the symptoms of cerebral shock, are much greater in hæmorrhage than in congestion. It must be remembered that the two states frequently coexist. From *softening* consequent on *embolism* cerebral hæmorrhage has also to be distinguished. The subjects of the latter are usually of an earlier age than those of hæmorrhage; their vessels are healthy, but they have organic heart-disease, which is often grave. There may be evidence of embolism elsewhere, in spleen, kidney, or retina. Loss of consciousness is often absent in embolism, and the paralysis often comes on deliberately, and is almost always brief in duration. Deep apoplectic coma should always lead to a suspicion that hæmorrhage is the lesion, and this especially in cases of young persons with heart disease. It is important not to let the presence of heart-disease exclude the idea of hæmorrhage, because it is in such cases that the most severe forms of hæmorrhage are met with, when there is an aneurysm, due to embolism, and this has ruptured. From *softening* due to *thrombosis* the distinction is often difficult. Age, and the state of the vessels, no longer serve as guides. The presence of chronic Bright's disease is slightly in favour of hæmorrhage; atheroma, the cause of softening in late life, being also induced by it, but only to a slight extent. Excitement at the time of the onset suggests hæmorrhage; depression, physical or mental, suggests softening. The occurrence of previous hemiplegic attacks points to softening. In the attack, loss of consciousness is much more considerable, in proportion to the subsequent paralysis, in hæmorrhage than in softening. But the distinction on this ground is often very difficult, since loss of consciousness may be absent in slight hæmorrhage, and considerable in an extensive softening. A deliberate onset is in favour of softening; and so are much mental change, and early rigidity. A definite fall of temperature is generally caused by rupture of a vessel, and so also is a rise within twelve hours. Paralysis of sudden onset, in cases of *tumour*, may be ascribed to hæmorrhage, to which it is indeed sometimes, but not always, due. Usually, enquiry elicits a history of gradual, long-continued symptoms; intense headache and optic neuritis are strongly suggestive of a tumour into which a hæmorrhage may have occurred.

Hæmorrhage into the substance of the brain is distinguished from *meningeal hæmorrhage* by the pain and mental excitement being less conspicuous, convulsion rarer, and by the presence of symptoms of a local lesion. *Hæmorrhage into the ventricles*, which resembles meningeal hæmorrhage in the generality of its symptoms, is usually distinguished by succeeding the symptoms of a circumscribed lesion.

Prognosis.—During the attack itself the prognosis in hæmorrhage into the brain must be guided by the intensity of the symptoms, and by the place of the lesion, as far as that can be ascertained. Death is probable if the coma is profound, or has not begun to lessen at the end of twenty-four hours, and if the early depression, or the subsequent rise of temperature and pulse-rate, is great. Most cases are hopeless in which there is marked interference with respiration—even hiccough is a cause of anxiety. When the symptoms indicate ventricular hæmorrhage, or hæmorrhage into the pons, there is little chance of survival. In meningeal hæmorrhage with coma the prognosis is exceedingly grave. Consciousness being recovered, and the danger of immediate death over, the freedom from much secondary pyrexia, from lung-congestion, and from bedsores, is a favourable indication. The chance of recovery from the paralysis is estimated by evidence of position of the lesion, and by any indications of improvement. Early contraction of the flexors is unfavourable. The danger of recurrence is in proportion to the extent of vascular disease, and the existence of irremovable causes of increased arterial tension. Hence the prognosis is rendered unfavourable by advanced age, or chronic renal disease, and by the evidence of general premature decay.

Treatment.—*During the attack.*—Rest is the most important. The patient should remain, as far as possible, where he is seized; stillness must be secured; and all effort is to be avoided. The posture should be recumbent, with the head raised, and flexion of the neck should be avoided. Any cause of passive cerebral congestion, such as a tight collar, must be looked for and removed. Venesection was formerly almost always employed in such cases—certainly too universally, but is now quite discarded—perhaps too absolutely. Loss of blood lessens the force of the heart and vascular tension; it thus hastens the cessation of external bleeding. Doubtless it acts in the same way in internal hæmorrhage. It may be used with probable advantage if the arterial tension is great (that is, if the pulse is incompressible), the heart acting strongly, and there is reason to believe that the intracranial hæmorrhage is increasing. A small quantity of blood should be taken rapidly. In ventricular hæmorrhage, venesection is probably powerless for good. When this is the case, it may not be equally incapable of doing harm in other ways too obvious to be pointed out. Fashion should neither determine treatment nor be forgotten as influencing the estimate formed by the friends of a sufferer. Venesection should not be employed where there is any evidence of failing heart-power. Its indications are drawn as much from the state of the patient, as from the fact of hæmorrhage. Bright's disease is no contra-indication.

If bleeding is not employed, the object to be aimed at by other measures must be to lower the arterial pressure within the skull, by keeping down the heart's action, by reducing the volume of the blood, and by diverting the blood as far as possible from the brain, by relaxing the systemic vessels, while endeavouring to obtain contraction of the cerebral vessels. Warmth may be applied to the limbs, aided by sinapisms. Dry-cupping to the surface, and purgatives, as croton oil or calomel, will divert the blood to the surface, or to the capacious intestinal vessels. Drugs which would cause contraction of the vessels are to be avoided, since their influence being on the smallest vessels and universal, their tendency is to increase arterial tension and hæmorrhage. To this, however, digitalis is an exception, since its action seems to be chiefly on arteries larger than those that burst. Diuretics are of great value, and their administration should never be neglected. Contraction of encephalic vessels may be furthered by cold to the head or sinapisms to the neck, according as the head is hotter or colder than normal. The heart should be allowed to fall a little below the normal in force, but failure of power must be warded off by stimulants given with great care. Convulsion is more effectually checked by cold than by bromides; the latter may be given if the convulsion recurs.

After the attack.—During the stage of irritation, rest must be maintained, and all sources of annoyance must be avoided. The bowels should be kept gently open by laxatives or by injections. Stimulants must be avoided, and the diet should be light. Pain may be relieved by cold to the head, a blister to the neck, or by Indian hemp, bromide of potassium, or a small dose of hyoscine.

During reparation the diet must be nutritious, but carefully regulated; and constipation of the bowels must be avoided. Rubbing of the limbs, and their gentle exercise, will aid their recovery; and after the symptoms of irritation have passed, faradisation will improve muscular nutrition, and is especially indicated where rapid loss of irritability indicates probable wasting. Nervine tonics probably aid a little the recovery of slightly damaged structures: quinine and strychnine, or very small doses of phosphorus if there is no kidney-disease. In anæmia the syrup of the phosphate of iron is good. Warmth, change of scene, and cheerful mental surroundings are useful adjuncts, especially in the later stages of recovery.

W. R. Gowers.

BRAIN, Hyperæmia of. — SYNON.: Congestion of the Brain.

DEFINITION.—Increase in the quantity of blood within the capillaries of the brain, other than that which is merely the early stage of inflammation.

Since neither the arteries nor the veins of the brain-substance can be over-distended with blood without capillary hyperæmia, and since it is to capillary hyperæmia that the functional disturbance of the brain is related, this may be justly taken as the essential pathological element in cerebral congestion. The congestion may be *active*, when the capillaries contain, in consequence of arterial distension or dilatation, an increased amount of oxygenated blood passing rapidly through them; or it may be *passive*, when, from venous obstruction, the increased blood in the capillaries is slowly moving, and is becoming, or is in great part already, venous.

'Congestion of the brain' is often alleged because no other explanation of symptoms occurs to the mind of the practitioner, although there may be no real evidence of such a state. Like 'congestion of the liver,' it is often adopted merely because it is a convenient refuge for a destitute diagnosis, and pleases the patient as an explanation which both satisfies and gratifies him. But it should never be assumed on purely negative evidence. Some descriptions of it have been written entirely from cases of hypochondriacal dysæsthesia.

ÆTIOLOGY.—(A) *Active* congestion of the brain may be general or partial. Of the *general* form the *remote* causes are as follows:—Men are said to be more liable to it than women. Age increases its frequency, chiefly from the greater frequency of its causes; yet children, from the sensitiveness of their vaso-motor system, occasionally suffer from active cerebral congestion. Heredity has only an indirect influence. The plethoric condition, with its tendency to general overfilling of the vessels, is a powerful predisponent. The *immediate* causes of excessive flow through the arteries of the brain may be thus stated: (1) Increase in the blood-pressure—either general, from excessive action of the heart (as in extreme hypertrophy or functional overaction); or partial, from an obstruction elsewhere, throwing an undue proportion of the pressure upon the cerebral vessels. This is seen in contraction of the aorta beyond the origin of the vessels to the head, and in sudden contraction of a large number of the systemic arterioles, as those of the surface, in exposure to cold and in ague. In some states, as Bright's disease, its influence on organs is partially counteracted by the contraction of the smaller arterioles. It results similarly from all cardiac excitement, whether due to mental or physical causes. (2) Active arterial dilatation of vaso-motor origin may be excited by prolonged mental work, severe emotion, insolation, digestive disturbances, or from the presence in the blood of various poisons, such as alcohol, and amyl-nitrite or nitroglycerine. In these cases the vaso-motor disturbance may precede and cause, or may succeed and result from, the overaction of the brain-tissue, which is intensified by it. It occurs in the second stage of many attacks of migraine. This cause may be conjoined with excited action of the heart, as in exophthalmic goître. In acute alcoholic poisoning the cerebral congestion is, as Niemeyer suggested, secondary to the disturbance of brain-tissue, although the simultaneous flushing of the face makes this doubtful; in chronic alcoholism the congestion may be primary. In pyrexia the headache and delirium have been thought to be due to congestion, but more likely result from the blood-state. (3) Lessened atmospheric pressure may cause congestion of the brain, as in the 'Zenith' balloon-catastrophe; and it probably occurs when divers pass from the increased to normal pressure. (4) Gravitation in the recumbent posture may alone cause cerebral hyperæmia, or may powerfully aid other causes in producing it.

Partial active congestion of brain-tissue occurs chiefly from disease of the arteries, which perverts the local distribution of the blood-pressure; in organic brain-diseases, as tumour, hæmorrhage, &c.; after blows on the head; and probably also from local overaction of special centres. It may also be due to a slight degree and transient duration of the activity of the causes of local inflammation.

(B) *Passive* congestion of the brain, when *general*, is the result of impeded return of blood from the head. It is intense in death from all forms of suffocation or by hanging. It may be due to pressure on the veins in the neck, as by tumours or tight collars; pressure on the innominate veins by tumours or aneurysm; or obstruction to the circulation from violent respiratory efforts, as exertion, cough, or blowing wind-instruments. It may be caused by impediments within the circulation, such as tricuspid insufficiency and its causes in the lungs, or even by disease on the left side of the heart. The recumbent posture assists all these influences.

Partial passive congestion may occur from pressure on a cerebral vein, from local venous thrombosis, or from pressure by a growth on one of the cerebral sinuses.

ANATOMICAL APPEARANCES.—The capillaries are not visible to the naked eye even when over-distended, but with the microscope they are seen to be dilated, often to twice their normal calibre. Their distension is indicated by a deeper and reddish tint of the grey substance; and the fulness of the small arteries and veins shows itself in an increase, often very great, in the number and size of the red points visible on section of the white matter. In active congestion the arteries are said to be distinctly larger than normal, and their perivascular spaces lessened in size; the minute vessels of the meninges are distended. Indeed in all forms of general congestion, the state of the vessels is generally more distinct in the pia mater than in the substance of the brain. Even in those, however, it is chiefly the congestion that would pass on to inflammation, or is really its first stage, that leaves distinct traces. In passive congestion the veins and sinuses are gorged with blood. It must be remembered, however, that such engorgement of the veins occurs in all cases of death from interference with the passage of the blood through the thorax, and that the vessels of the most dependent portion are always fullest. The state of the cerebral veins must therefore be carefully compared with that of the veins of other organs. Active congestion may sometimes leave no visible traces. After a time blood-pigment collects outside the vessels (Bastian), and serous effusion into the membranes and ventricles may be found in all forms. After a long-continued congestion, the vessels may be permanently distended; degenerative changes, consequent perhaps on the effusion of serum, may lead to the appearance of wide spaces around them; and the whole brain may have undergone distinct wasting. It must, however, be pointed out that the absence or paucity of post-mortem evidence is equally true of the skin, and does not establish the absence of congestion during life.

Symptoms. — It is probable that many symptoms have been erroneously ascribed to cerebral congestion; some because hyperæmia, due to the mode of death, was found *post mortem*; others because an assumed congestion was the readiest explanation.

The symptoms commonly referred to cerebral congestion may be grouped in two classes—those of excitement, and those of depression. Either of these may exist alone; those of excitement may precede those of depression; or they may partially co-exist. They may be slight or severe; acute or chronic. In all cases they are increased by the recumbent posture or depressing the head, by expiration, coughs, and effort; and they are usually aggravated by constipation, and by indulgence in alcohol.

1. *General.*—In general cerebral hyperæmia, among the symptoms of excitement may be mentioned mental irritability; headache—slight or violent, with feelings of fulness or throbbing in the head, and vertiginous or other unpleasant sensations; increased or perverted functions of the organs of special sense, such as flashes of light and noises in the ears; contraction of the pupils; sleeplessness; restlessness, startings, twitchings or slight actual convulsions; and mental excitement. The pulse is quick. There may be vomiting. The face varies, participating in the congestions of circulatory origin, and in some of vaso-motor disturbance, such as that which may occur during digestion. In other forms of supposed congestion of vaso-motor mechanism, as in those which result from excessive brain-work, the face may be pale, but the nature of these cases is doubtful.

Among the symptoms of depressed brain-function, are dulness of the special senses; motor weakness; mental indifference and slowness; somnolence, especially after meals; dilatation of the pupils; and infrequency of the heart's action. Consciousness may be lost suddenly, and the loss, it is commonly believed, may deepen into coma, but this is seldom absolute. As a rule there is no fever, but in children the temperature may be raised a degree or so.

In the *chronic* forms of cerebral congestion, these symptoms, variously grouped and moderate in degree, continue for days, weeks, or months. Their course is marked by great variability. Durand-Fardel has pointed out that in these cases there is often much viscid secretion of the conjunctiva.

In the more *acute* forms of cerebral congestion, the symptoms of muscular spasm, of mental disturbance, or of loss of consciousness, may be so predominant as to give a special character to the attack:—

a. In the *convulsive* form pain or uneasiness in the head commonly precedes the muscular spasm. The latter is usually deliberate in onset. It is said sometimes to be unilateral at first, and afterwards general, but more frequently it is general throughout. Tonic may precede clonic spasm, and the attack resemble an epileptic fit, or clonic spasm only may be present, or slight general tonic spasm. Consciousness may or may not be lost; if lost it is for a very short space of time.

b. The *delirious* form is seen under two aspects—(1) in old age, after emotional excitement; in this the wandering is slight, and often related distinctly to the recumbent posture, or to a low position of the head; (2) a much more violent delirium, which is apparently related to cerebral congestion, is seen sometimes after mental work or emotional excitement, or after alcoholic poisoning. It often resembles and may end in mania, but there is no pyrexia. Occasionally death results.

c. The *apoplectic* form is marked by sudden loss of consciousness, occurring commonly during effort. The unconsciousness usually lasts only a few minutes, and incomplete general weakness remains for a day or two. In rare cases the loss of consciousness deepens into coma, with stertorous breathing and relaxed sphincters, and death may occur from the extension of the cerebral depression to the respiratory centres.

d. Vertiginous sensations sometimes give a character to an attack.

In children congestion of the brain is said to be a rare but occasional cause of convulsion or delirium. Headache and contracted pupils make up a group of symptoms resembling meningitis, but fever is rarely present, and if it exists it is slight, and the symptoms usually come on suddenly and pass away in a day or two. Death, however, sometimes occurs soon after the onset of the attack, especially in the convulsive form. Periodical attacks of this character may change to those of migraine in later life.

2. *Partial.*—Partial hyperæmia leads to localised symptoms of excitement or depression of function. Local convulsion or paralysis may result. Headache is often intense and localised. If nothing more than congestion is present, the symptoms usually soon pass off.

PATHOLOGY.—The possibility of the variations in the quantity of blood within the brain has been denied on the ground that the cerebro-spinal circulation is carried on within a closed cavity. But the statement is untrue in the sense that is relevant to the problem at issue, since the communication of the venous sinuses of the skull, and especially of the venous plexuses of the spinal canal within the exterior, with external vessels, is free, and affords a ready mechanism by which the amount of blood, even in the distant cerebral vessels, may be varied by the displacement of the cerebro-spinal fluid. This, it will be remembered, can pass into the perivascular spaces, and can readily yield to increased intravascular pressure, and thus make room for an increase in the quantity of blood within the arteries or veins.

The detailed pathology of cerebral congestion is, however, still obscure, since we know little of the relative part played by the blood-vessels and the nerve-elements in determining the form which disturbance of function shall take. An excessive supply of arterial blood is, in all organs, attended with functional activity, and it is easy to understand that active congestion should result in symptoms of excitement. Subsequent depression of function has been accounted for by inferring compression of brain-tissue by effused serum. The reaction of exhaustion may contribute. In passive congestion the nerve-tissue is imperfectly supplied with oxygenated blood, and compressed by distended vessels, and its functions are impaired by the presence of effete products. Hence the predominance of symptoms of depression over those of irritation.

DIAGNOSIS.—The diagnosis rests on the discovery of circulatory and other causes of cerebral congestion; on the circumstances of posture, effort, &c., under which the symptoms came on; on the existence of concomitant congestion in other parts supplied by the carotids, as the face (by no means invariable); on the general character of the cerebral symptoms; on their speedy disappearance; and on the absence, in the adult at any rate, of elevation of temperature. The diagnosis of the special forms of cerebral congestion from the diseases which they most resemble is considered under the head of those diseases. It may, however, be mentioned that, on the one hand, persistent focal symptoms exclude mere congestion, and that, on the other hand, the condition is likely to cause an error in cases in which the various cephalic sensations of pressure, fulness, heat, &c., which seem to the hypochondriacal sufferer suggestive of congestion, are generally pseudo-neuralgic in nature. It is in these cases that it is within the power of the doctor to do great harm by increasing the apprehensions of the patient, by encouraging the erroneous opinion and so increasing the influence of attention in augmenting the distress.

PROGNOSIS.—The prognosis is generally immediately favourable; but in a severe attack of any form, death may occur. The apoplectic form is most dangerous, the convulsive least so. Degenerated vessels increase the immediate risk to life. After many attacks, permanent nutritional changes in the brain often supervene.

TREATMENT.—The most important elements in the treatment of cerebral congestion are posture, removal of blood, purgation, cold to the head, and warm and stimulating applications to the surface. Whatever be the cause, it is important to raise the patient's head, so that gravitation may impede the flow and aid the return of the blood. By this means alone, insomnia from hyperæmia may often be prevented. The removal of blood is useful in extreme forms of congestion, either active or passive, especially in those forms of active congestion in which the face participates. Venesection or leeching may be employed, according to the severity of the attack; in active congestion the blood which is taken should be removed quickly. The relief which in such cases follows an epistaxis illustrates the value of this method of treatment; and we may take a lesson from nature and, in some cases, apply a leech behind the ear, where there are communications between the circulation inside and outside the cranium. It is not advisable in those cases in which, from overaction of brain-tissue, or from cold to the surface, dilatation of the cerebral vessels results while the surface remains pale. In all forms of congestion, purgation is useful. It removes from the blood some of its serum, and it affords immediate relief to the cerebral circulation, by causing an afflux of blood to the capacious intestinal vessels. In plethoric states, diuresis is also most useful, and has succeeded where venesection and purgation failed. Cold to the head is of most value in reflex or secondary dilatation of the cerebral vessels, as after mental work, insolation, fatigue, and in some toxæmic states. In the same class of cases, stimulation of the peripheral nerves by sinapisms, blisters, &c., applied to the neck, will not only draw blood to the surface, but also, by reflex influence, assist in obtaining arterial contraction. Hot applications to the limbs act in a similar manner, causing local afflux of blood and thus lessening the tendency to encephalic engorgement. Recourse may also be had to mechanical appliances for increasing the quantity of blood in the limbs. This element in treatment is most useful in active congestion. Alcohol and opium must be avoided in all forms of active congestion, but in passive congestion they may be of service. Bromide of potassium is useful in those cases in which the congestion is produced by vaso-motor mechanism, excited either by stimulation of brain-tissue or of distant nerves. In passive congestion from heart-disease the treatment is that of the cardiac condition, digitalis, strophanthus, and diuretics being of especial service. All persons liable to congestion of the brain should live regularly, avoid hot rooms, and attend carefully to the stomach and bowels, relieving the latter by frequent moderate purgation. W. R. GOWERS.

BRAIN, Hypertrophy of.—Hypertrophy of brain is a misnomer. True hypertrophy would consist of increase in number or in size of the nerve-cells, nerve-tubes, connective stroma, and supplying vessels; and there might be expected, as a result of this condition, some manifestation of a higher intellectual development. Such a condition is never found. A so-called hypertrophied brain is one that is larger and heavier than normal. On removing the skull-cap, the encephalon seems to expand, so as to render it difficult to affix the bone-covering in its place; the membranes are dry; the sulci have nearly disappeared, and the whole organ appears pale and bloodless. On section there is a sensation of toughness, though less in degree than in a case of general sclerosis. There is no sign of pressure upon the orbital plates, such as is met with in chronic hydrocephalus. The lesion affects only the cerebral hemispheres, especially on the convex surface, and perhaps the posterior lobes in particular. The base of the brain and the cerebellum are unaffected except by pressure.

On minute examination, the nerve-cells and nerve-fibres, far from being found augmented in number or in size, may even be compressed and diminished; and there is often also some interference with the normal calibre of the vessels. Gintrac, however, records a case in which the calibre of the nerve-tubes was almost double that of the normal. What increase there is affects the white matter of the brain, and this structure is very pale and of an elastic consistence. The real and sole lesion is hyperplasia of the connective tissue. It differs from sclerosis in affecting the cerebral hemispheres more universally than is the case with sclerosis; and also that in sclerosis there is not only increase of the connective tissue, but subsequent retraction, and, as a frequent consequence of this, an absolute destruction more or less of the nerve-elements of the organ. When the disease is far advanced it may possibly cause absorption of the inner table of the skull, and thus produce a roughness or thinning of the bone, or, in extreme cases, even perforation. The sinuses are generally distended with blood. Hypertrophy of smaller portions of the brain is rare: still various cases are on record in which, under the name of neuromata of the nervous centres, white or grey matter has been found in certain parts of the brain over and above the normal constituents of this organ. Hyperplasia of the pineal gland is closely allied to glioma. It should be distinguished from encysted dropsy of that organ.

In most cases of so-called hypertrophy of a small part of the brain the lesion is an infiltrating growth.

ÆTIOLOGY.—Hypertrophy of the brain has been said to be sometimes secondary, and caused by the irritation of morbid growths. This, however, is rare. It is generally primary, and may be a disease of intra-uterine life; but it is generally developed after birth, especially in rickety children. Some forms of encephalocele, without hydrocephalus, seem to be due to the growth of compact masses of cerebral substance in excess of what is normal. The conditions for the production of this morbid state are infancy; bad diet; repeated congestion of the cerebral vessels, such as might be induced by frequent cough; and perhaps lead-poisoning.

SYMPTOMS.—The symptoms of so-called general hypertrophy vary according as the sutures are closed or not. If, from insufficient occlusion of the sutures, the head expands in proportion to the increase in size of the encephalon, the symptoms may be very slight. Children thus affected show no intellectual hebetude. In them, as long as the abnormality is uncomplicated with local inflammation of membranes or with hæmorrhages, there may be no headache, no affection of sight, no sensory or motor paralysis, and no convulsions. Convulsions, however, are common in cases in which the occlusion of the sutures has prevented expansion of the head proportionate to the internal increase of tissue. In such cases also there is generally more or less motor paralysis, often some anæsthesia of the limbs, headache, vomiting, and mental hebetude—symptoms, in fact, either of marked interference with the intra-cranial circulation, or of irritation from inflammatory complications. The prognosis is always bad, but in rachitic cases the course may be chronic.

TREATMENT.—All treatment seems to be ineffective in diminishing cerebral hypertrophy. E. LONG FOX.

BRAIN, Inflammation of.—SYNON.: Encephalitis.—Encephalitis is a term which ought perhaps to be strictly limited to inflammatory changes in the brain-substance itself, to the exclusion of all forms of meningitis. It may be either *diffuse* or *local*, but for our present purpose we have chiefly to do with the diffuse form. Local encephalitis will generally result in abscess (*see* BRAIN, Abscess of), and will usually be met with, if we put aside the results of injuries, in association either with disease of the ear, with tubercular growths, or with pyæmic deposits.

It may perhaps be doubted whether the occurrence of diffuse inflammation of the brain-substance as an acute disease has as yet been proved, excepting as a result of wounds. Even as a traumatic lesion, its special features have by no means been accurately studied. It is, however, highly probable that, after penetrating wounds of the brain, its substance may inflame, just as the cellular tissue of a limb may, the inflammatory processes beginning at the site of the wound and rapidly spreading through a large part of the hemisphere. It is probably in the perivascular spaces that the process chiefly spreads, and it is in these that the microscope will detect the most abundant results. Such a condition of diffuse encephalitis may exist without there being any visible changes in the brain. It may perhaps be a little softened or a little congested, but very probably there is nothing about which the most experienced pathologist could feel certain until the microscope is resorted to.

SYMPTOMS.—It is not possible in the present state of our knowledge to speak with any certainty of the symptoms of diffuse encephalitis. They will vary, of course, with the region affected; and disturbance of function, followed by more or less complete loss, will be the most frequent occurrence.

TREATMENT.—When the symptoms of encephalitis are once recognised, it will usually be too late for treatment, and measures of prevention are those of chief importance. The early use of mercury, beginning in anticipation of symptoms, rather than waiting for them, is probably the most important; and next to it come cold to the head, purgatives, and counter-irritation.

JONATHAN HUTCHINSON.

BRAIN, Laceration of.—In the more strict sense of the word, the brain is but little liable to laceration from injury. Yet, in connexion with injuries, such as penetrating wounds of the skull, fractures with great depression of bone, and even with violent concussions, the brain-substance is not infrequently, to some extent, torn. In so soft a structure, however, and under the influence of modes of violence which are usually rather of the nature of blows than of anything likely to cause stretching, we rarely meet with results comparable to laceration of any of the firmer textures of the body. Whenever the brain is 'lacerated' it is also contused, and the contusion often extends widely around the rent, and is by far the more important lesion. In the peripheral parts of the brain-mass this is especially true, and it is of little practical use to speak of lacerations excepting as complications of very severe contusions. In the central parts, the crura especially, we meet now and then with a laceration properly so called, and it is not very infrequent to find the trunks of single nerves torn across. The consideration of those forms of laceration which are produced by the effusion of blood from ruptured vessels of size sufficient to supply a stream forcible enough to break up the surrounding substance, will be found in the articles APOPLEXY, CEREBRAL; and BRAIN, Hæmorrhage into.

In the case of injuries to the head from falls or blows without perforation, certain definite parts are prone to suffer from contusion and laceration. Usually some slight evidence of injury is found immediately beneath the part of the skull upon which the blow was received, but by far the chief bruising will be at the opposite point. If the occiput be struck, the anterior lobes will be contused; and if one parietal eminence, the opposite sphenoidal lobe. This law, however, is greatly modified by the differing conditions under which different parts of the brain-mass are placed as regards their surroundings. In the posterior half of the skull the brain-mass is bulky, and between its hinder lobes and the cerebellum is a strong flexible membrane, well calculated to break vibrations gradually, and thus to prevent contusion. Nor are there in these regions any strongly marked bony ridges against which the brain might be dashed. These conditions are reversed as regards the anterior lobes and the middle lobes, and the consequence is that, whilst severe contusions are often seen in the latter, they are much more rare in the cerebellum and posterior two-thirds of the brain-mass. In cases of compound fracture, with tearing of the dura mater, and deep depression of bone, the brain-substance may, of course, be injured at any part; but even in respect to this kind of violence the hinder regions of the skull are specially protected.

SYMPTOMS.—We know enough of surface-laceration of the brain in parts other than the anterior and middle lobes, to be able to assert that, unless the lesion extend very widely or deeply, it does not reveal itself by any special symptoms. If very extensive, weakness of the opposite limbs and side of the face is usually observed. Injury to the anterior lobes, unless extensive, cannot be diagnosed, but it may be guessed at in a few cases where the sense of smell is lost in one or both nostrils; for it is very common for the olfactory bulbs to be damaged at the same time. If the anterior lobes are severely lacerated, the symptoms will be those of very severe concussion, with the difference that insensibility is more nearly complete, and that it increases instead of diminishing as the days pass on. When a sphenoidal lobe is contused there is usually, according to the writer's observation, incomplete hemiplegia of the opposite side, involving sensation as well as motion, and the face as well as the limbs. From these symptoms the patient may, in the course of months, wholly recover. It is usually the apex of the sphenoidal lobe which is lacerated, but if the lesion extends higher, and if it occurs on the left side, aphasia may be present.

In connexion with recent research (Dr. Hughlings Jackson, Dr. Ferrier, and others) as to localised functions, we are now able to diagnose with considerable accuracy the precise regions injured.

TREATMENT and PROGNOSIS.—In the treatment and prognosis of lacerations and contusions of the surface of the brain, much depends upon whether or not the case is complicated by compound fracture and the admission of air. If air have been admitted there is risk of meningitis or encephalitis, denoted in either case by the occurrence, within a few days of the injury, of hemiplegia of the opposite side. To prevent this must be the object of treatment. The scalp should be shaved, the wound closed with sutures as far as practicable, and lint wetted in a spirit-and-lead lotion should be laid over the part and systematically re-wetted every hour. If the case be treated in hospital it may be well, in addition to this, to wash the wound with the lotion before closing it, or to dress with Lister's antiseptic precautions. In cases of laceration without access of air, death may ensue from diffuse softening around the part. If this happens the case will probably end within a week or ten days. It is probable that many cases of fractured base with more or less severe laceration of brain recover; in some with permanent paralysis, but in others without. It must be added that many of the cases in which death occurs within a few hours or a day or two after fracture of the base are attended by laceration. In these the symptoms are often difficult to distinguish from those of compression. Profound insensibility, a bloated face, stertorous breathing, and a full pulse, are often present; but they may be substituted by pallor and a feeble pulse in connexion with great depression of the heart's action. If any deviation from symmetry as regards the paralysis of the limbs can be proved, it is in favour of laceration and against compression, but the differential diagnosis is a matter of extreme difficulty.

Laceration of Cranial Nerves.—Lacerations of single nerves within the cranial cavity are not by any means uncommon. This occurrence is to be suspected whenever the parts supplied by a cranial nerve are completely paralysed, without accompanying symptoms indicative of severe lesion of the brain-mass. Cases of laceration of the brain itself may be complicated by laceration of nerve-trunks, and thus the symptoms may become difficult to interpret with confidence.

Of single cranial nerves the olfactory bulbs are the most liable to suffer from contusion; and the third, fourth, and sixth nerve-trunks are those most frequently torn through. JONATHAN HUTCHINSON.

BRAIN, Malformations of.—The malformations of the cranium and its contents may be divided into two series:—A. Those which are scarcely compatible with life; and B. Those in which life is possible, although the intellectual power may be more or less modified from a healthy condition.

A. The *first series* will include at least seven forms, in all of which life is so rare that it is impossible to speak of more than the pathological anatomy.

1. *Dicephalia*—in which two heads are found upon a single body, or upon two bodies pretty extensively connected. In the first variety, one head may be attached to the vault of the palate of the other, or may be united to the convexity of the skull. In the second variety the heads may sometimes spring from a single neck. This dicephalous condition is frequently accompanied by malformation affecting the spinal column and spinal nerves, as well as by some incompleteness in the development of the brain.

2. *Monocephalia*—the union of two heads into one, on two separate bodies. The two cranial cavities are united into one. Dissection of the dura mater points to this membrane having been formed out of two, and in like manner the cranial contents are either double, or appear to be single from the union of double organs.

3. *Acephalia*—the complete absence of head. An acephalous monster is usually a twin; and when this is not the case, it is associated with the morbid condition of the uterus of the mother known by the name of uterine hydatids.

4. *Paracephalia*—the head not entirely wanting, but deprived of most of the cranium and of the face. A monster of this kind is generally a twin.

5. *Anencephalia.*—The absolute meaning

of this term would be the absence of all cranial contents, but it is made to include certain varieties, differing according to the amount of the encephalon developed. The aspect of the head, resembling that of a frog, the considerable projection of the eyes, the flattening of the forehead, and the absence of the cranial vault, are the chief characteristics of this abnormality.

In the first degree, there is absence of cerebrum, cerebellum, mesocephale, and spinal cord. In cases of this kind the cranial vault is generally absent, and the bones at the base of the skull are convex and thickened.

In the second degree, the cerebrum, cerebellum, and mesocephale are absent, but a portion of the spinal cord is found. This portion of cord is most usually the lower part.

In the third degree, the spinal cord is pretty complete, but there is still an absence of the cerebrum, cerebellum, and mesocephale.

A few cases have been recorded of the fourth degree, in which no cerebrum or cerebellum is found, but a normal spinal cord, and a pretty complete mesocephale.

In the fifth degree, the cerebrum alone is entirely or almost entirely absent, whilst the rest of the nervous centres are present, though not always in a perfectly complete condition. The seat of the absent cerebrum is often filled by fluid.

Lastly, one case has been recorded in which the cerebrum was present, whilst the cerebellum, mesocephale, and spinal cord were wanting.

Anencephalia, like the other previously mentioned malformations, is due to arrest of development, such arrest depending either on physical injuries to the uterus at a very early period of pregnancy, or to some mental shock experienced by the mother during the first two months after conception. It differs from acephalia, not only by the partial formation of the head, but by the presence of the heart, and other thoracic organs. The ganglia of the sympathetic are usually well-developed.

6. *Pseudencephalia.*—In this malformation there is anencephalia *plus* a very considerable thickening of the meninges, which take the place and often imitate the aspect of the brain. Its varieties exactly correspond to those of anencephalia. The tumour formed by the development of the membranes is of variable size and position. It may be frontal, fronto-parietal, or occipital. The real seat of the lesion is the pia mater. The abnormality consists in extreme hypertrophy of this structure, with complete arrest in the development of the encephalon, or of some portion of it. Several observers have recognised certain vesicles in the interior of the membranous tumour, and these have been supposed to be cerebral cells in process of development. It is more in accordance with observation to believe with Gintrac that they are connected with the development of the choroid plexus.

7. *Cyclocephalia.*—In this monstrosity there is an approximation or actual fusion of two eyes in a common orbit. It is connected with certain abnormalities in the brain, that militate against viability, or at least prolongation of life. The brain itself is generally more or less deficient, especially in its anterior and central portions, and in some cases the nose and mouth are very ill-developed.

B. The *second series* of cases owe their abnormal conditions to injury arising in the course of fœtal life; and some forms at least may be due to lesion occurring at a later period than in the first series.

8. *Atelencephalia*—incompleteness of brain or of membranes—is the chief of these forms. This incompleteness manifests itself in seven varieties, according to the part of the encephalon injured by the lesion.

In the first variety, the dura mater is somewhat deficient, being altogether absent in certain situations at the base of the brain. The falx cerebri may be wanting; or from incomplete development it may seem perforated with holes; or the tentorium cerebelli may be absent. There are no symptoms which allow a positive diagnosis of any of these lesions during life.

In the second variety, there is general incompleteness of the brain, or imperfection of several portions of it at one and the same time. Whilst the cranial vault is thrown back, and the lower jaw is short, the base of the skull is large, the cerebral convolutions almost absent, and the cerebellum large. The head is almost always small, and it may present various irregular forms. This coincides with certain internal lesions, partial or general atrophy with consequent serous effusion under the membranes, inflammatory conditions, or thickening of the cranial bones and of the meninges. The incompleteness of the brain varies exceedingly, from a condition in which the whole brain is atrophied, to spots of deficiency, such as the absence of a single convolution, of the septum, or of the pineal gland. The symptoms will necessarily vary much according to the amount of cerebral incompleteness. Where this is general, affecting in some degree all the convolutions, the intellectual powers, as in the microcephalous Aztecs, will be very slightly developed, and their language of the very simplest form. With the brain still more imperfect, there is generally complete idiocy, or a condition closely allied to it. The special senses are dulled, particularly sight and hearing. Speech is in abeyance, or is limited to monosyllables. There are various motor phenomena, such as muscular debility, hemiplegia, paraplegia, contraction, convulsion, loss of power over sphincters, dysphagia, vomiting, or feebleness of respiration.

The third variety includes incompleteness of the central parts of the brain. The corpus callosum, the septum, the fornix, the corpora striata, and the cornua ammonis may be imperfectly developed. The cerebral hemispheres may thus be in some sort fused together, and the shape of the ventricles altered. The symptoms differ from those of the preceding variety, in that the special senses are seldom involved; and that, although complete idiocy may accompany these lesions, it is more usual for the brain to be found capable of some slight intelligence, though unequal to the conception of abstract ideas.

In the fourth variety, the lateral portions of the brain are incomplete. This lesion generally occupies one side of the brain, leaving the other hemisphere intact. Several points in the hemisphere may be affected, or the whole of a single lobe. Most usually there is a depression occupying the seat of one or more convolutions. Such a lesion occasionally attacks the whole hemisphere, giving it the appearance of a large pouch filled with fluid. Sometimes also the neighbouring ventricle communicates with it; or there may be much ventricular effusion, with imperfect development of the corpus striatum, the optic thalamus, the cornua ammonis, the mammillary tubercle, the crus cerebri, and the optic and olfactory nerves of one side. In a considerable proportion of patients so affected, the lesion is accompanied by idiocy, and possibly the inability to speak is connected with this mental condition. Some few patients, however, possessed with some intelligence, have yet been unable to speak; this has been the case even when the lesion has existed on the right side. Deafness is rare; feebleness of sight, various forms of strabismus, and nystagmus common. Very frequently there is hemiplegia of the side opposite to the lesion, and certain other affections of the limbs—emaciation, incomplete development, contraction, various deformities of the hands, &c. Sensation even in the paralysed limbs is normal; convulsions are not uncommon.

In the fifth variety, there is incompleteness of the anterior portion of the brain. Here both the anterior lobes are affected together. This condition may be associated with some deficiency of the corpus callosum, fornix, and corpora striata. Idiocy is not uncommon; mutism is the rule, but in some patients not idiotic a few words have been possible. Other phenomena — amaurosis, strabismus, and various motor abnormalities —have occurred so irregularly in these patients that it is probable they were symptoms not so much of this lesion as of certain further complications.

Incompleteness of the cerebellum forms the sixth variety. This is sometimes associated with a similar condition of one side of the brain. Usually one lateral lobe only is affected. General hydrocephalus is an occasional complication, and a collection of fluid under the tentorium cerebelli is very common. The symptoms are very negative. In general terms it may be said that there is no loss of muscular co-ordination, and no loss of sexual power.

In the seventh variety, there is incompleteness of the mesocephale and medulla oblongata. This is not carried very far. Certain modifications in form and volume are alone compatible with the preservation of life. It is not a common lesion, and has generally been associated with idiocy.

9. *Congenital hydrocephalus.*—One variety of this congenital effusion of fluid is rare, viz. when the fluid is outside the dura mater, between this membrane and the pericranium, and the cranial bones are found floating in the midst of the fluid.

The second variety is that in which the fluid lies outside the brain. The writer believes that serous effusion in this position is not the cause of the atrophy, flattening, or induration of the subjacent cerebral organs, but the effect: that where fluid is found in this situation it is only the consequence of some one of the lesions already mentioned notably atrophy of brain from whatever cause, and of atelencephalia. This view is, however, opposed to that of some authors.

The third variety is congenital hydrocephalus of the ventricles. In some such cases the increase in the size of the head occurs before birth; in others, not until after. The head increases rapidly in size in the first four weeks after birth. The sutures are widely separated, the cranial bones very thin, the integuments of the head injected, and the hair deficient. The muscles are badly developed, locomotion is imperfect, the intellect is generally obtuse, but the special senses are not particularly affected, unless it be that sight is deficient.

10. *Synencephalia* is merely a matter of pathological interest. The head of the fœtus is sometimes found adherent to the membranes or to the placenta, as a consequence of intra-uterine inflammation. At the point of adhesion the place of the cranial bone is taken by a thin vascular membrane. This condition is sometimes accompanied by, and indeed perhaps causes, encephalocele.

11. *Exencephalia.*—Here a large portion of the brain is situated outside the cavity of the cranium. Practically it includes all the other malformations of the brain that are yet to be spoken of. Thus, if only a limited portion of the brain finds its way outside the skull by an abnormal opening, the displacement is known by the name of *encephalocele*, or *hernia cerebri*; if this hernia coincide with a hydrocephalic condition of the ventricles, it is called *hydrencephalocele*; and if the hernia is composed not of the brain, but of the membranes, distended with

fluid it may be, the lesion is called *meningocele* or *hydromeningocele.* Exencephalia proper may be subdivided into *frontal*, *sincipital*, and *occipital*, according to the direction taken by the extruded brain.

In encephalocele only a portion of the brain, more or less limited, is found outside the skull. The exit takes place most frequently at the occipital, and next in the frontal region; but the temporal and parietal regions are occasionally the seat of this lesion. The symptoms may be very negative. Encephalocele, unless pressed upon externally, is not often attended by convulsions or paralysis, by intellectual feebleness, or by difficulty of speech. This latter symptom is sometimes found when the hernia includes the cerebellum. Neither is this lesion incompatible with the prolongation of life. The chief diagnostic difficulty is the possibility of the tumour being cephalhæmatoma, but this is frequently situated over the parietal bones, an unusual position for encephalocele: and external pressure of the former tumour causes none of the cerebral phenomena — stupor, dilatation of pupils, paralysis, convulsion, so constantly seen from compression of an encephalocele.

E. Long Fox.

BRAIN, Malignant Diseases of.—*See* Brain, Tumours and New Growths of.

BRAIN, Membranes or Meninges of, Diseases of.—*See* Meninges, Diseases of.

BRAIN, Morbid Growths of.—*See* Brain, Tumours and New Growths of.

BRAIN, Œdema of.—Definition.—Infiltration of the brain and pia mater with serum.

Ætiology and Pathology.—In chronic maladies attended with general œdema, especially Bright's disease, there is an increased amount of fluid around the brain—in the meshes of the pia mater and between the convolutions—and also in the ventricles. Occasionally the cerebral substance is infiltrated; but this is uncommon, and it probably occurs only when there is some change in the cerebral structure. The perivascular canals normally afford a ready means of escape for effused serum, and in Bright's disease, at least, the substance of the brain is often remarkably firm, so as to present a contrast to the condition of other organs. But apart from any general disease, all spaces that result from a diminution in the volume of the structures within the skull, are filled by serum. Thus in senile atrophy of the brain, the space between the shrunken convolutions is occupied by serum, and the ventricles contain an excess of fluid. The brain-tissue may also appear to contain more fluid than usual, in consequence of the presence of serum in the enlarged perivascular canals. Such effusion is also met with in those forms of insanity in which there are degenerative changes in the brain with a diminution in its volume. It is seen also in cases of rapid course, in which functional excitement is attended with some vascular disturbance. Conditions of hyperæmia and inflammation are attended with effusion of serum in the brain, as in other organs, and it is in cases of inflammation that the greatest amount of œdema is met with, but this condition is not included in the common use of the name. In passive congestion, however, such as results from heart-disease, enough serum may escape from the distended vessels to give rise to a condition of œdema; but it is probable that when the excess is more than trifling, room is made for it by wasting of the nerve-elements, the result of the continued pressure to which they are exposed.

When the degree of œdema is considerable, the cerebral substance may be enlarged, the convolutions being flattened; and the tissue is lessened in consistence owing to the infiltration of the cerebral tissue by the liquid, and the separation by it of the nerve-elements. A microscopical section shows empty round and oval spaces between the cells and fibres, limited by delicate tracts of the separated neuroglial tissue. The same softening is seen in the neighbourhood of effusions of fluid into the ventricles; the brain-tissue, for a depth of some lines from the ependyma, being softened to a pulpy consistence. Post-mortem imbibition always increases the apparent amount of the œdema and the degree of the softening, because the nerve-elements quickly begin to break up after death. In simple œdema the tissue remains pale, and the grey substance may be even paler than usual.

Symptoms.—Little is known of the symptoms of œdema of the brain. The pathological state is usually secondary to some other condition, the symptoms of which mask any that the œdema itself might possibly cause. General œdema seems attended by slow diminution of mental power and motor force, which may be in part due to the patient's state, but has many other possible causes. The effusion of serum in cases of congestion, and consequent pressure on the nerve-elements, has been considered as the cause of the symptoms of depression common in that condition. Cases occasionally occur in which effusion of serum into the ventricles and the pia mater is the only post-mortem condition to be found after an apoplectiform seizure, and such cases are often spoken of as instances of *serous apoplexy.* In so far as the effusion of serum is sometimes possibly related to the apoplectic attack, it can be merely as the consequence of a cerebral congestion which has left no recognisable post-mortem hyperæmia. In point of fact we know nothing of symptoms that can be ascribed to the œdema itself, and it is not easy to conceive a mechanism by which symptoms can result from it, so far as we are acquainted with its intimate pathology.

Treatment.—The treatment of cerebral œdema is usually secondary to the condition, commonly conspicuous enough, which is its cause—Bright's disease, passive cerebral congestion, &c. If œdema be suspected where no causal indication for treatment exists, purgatives and diuretics, with iron if there be debility, are the remedies most likely to be of service. But where a diagnosis is speculative, treatment necessarily lacks a confident basis.

The effusion of fluid into the ventricles is described under Hydrocephalus.

W. R. Gowers.

BRAIN, Sclerosis of.—*See* Spinal Cord, Special Diseases of: Multiple Sclerosis.

BRAIN, Softening of.—Definition.—A pathological state of brain-tissue, attended with diminished consistence; usually local; and indicated, during life, by mental, motor, and sensory symptoms, which vary according to the seat of the lesion. It is produced rapidly in the vast majority of cases, and is then usually dependent on vascular obstruction. Very rarely it is chronic in development, and the nature of the actual process is not known. The following description applies to the acute form.

Ætiology.—Acute softening of the brain, occurring during life, and not due to traumatic cause, is referable to one of two conditions, inflammation or vascular obstruction. Most cases were formerly thought to be due to inflammation; but it is now known that very few are. Inflammatory softening is described in another article (*see* Brain, Inflammation of). The vascular obstruction, which is the usual cause of softening, may be arterial or, rarely, capillary. Venous obstruction also causes softening, but the loss of consistence does not involve the whole of the tissue of the part, and enough remains to permit an ultimate restoration of firm tissue and even the production of induration. The arterial obstruction may be due to a coagulum formed *in situ* (thrombosis), or to a plug of fibrin conveyed to the spot by the blood-current (embolism). The chief predisposing and exciting causes of softening of the brain will therefore be the causes of these conditions (*see* Brain, Vessels of, Diseases of). The common concomitant conditions are—in thrombosis, vascular disease; in embolism, valvular disease of the heart; and as predisposing conditions we usually find—in cases of thrombosis, advanced age, Bright's disease, chronic alcoholism, gout, or syphilis;—in cases of embolism, acute rheumatism, chorea, or scarlet fever. Senile vascular degeneration is the most common cause of softening, and hence the disease is met with most frequently in the old. In rare cases, thrombosis occurs without disease of the vessels, from a state of the blood alone. It is probable that this is sometimes a cause of hemiplegia coming on a few days after child-birth, when there seems to be a physiological increase in the coagulability of the blood. Embolism, due to valvular disease of the heart, and thrombosis due to syphilitic disease, are the most frequent causes of acute local softening in the young and middle-aged. All these ætiological conditions are considered in more detail in the article on Diseases of the Vessels of the Brain.

Anatomical Characters.—The characteristic feature of cerebral softening is diminished consistence. This may, however, arise from either ante-mortem or post-mortem changes. In each case the diminished consistence depends on the breaking-up of the material, of which the nerve-elements are composed, into globules and granules, and the separation of these by an increased quantity of fluid. Thus the continuous structures of which the brain consists are broken up into disconnected fragments, and the consistence of the tissue is accordingly diminished. In post-mortem softening there is nothing more. The globules of myelin are often large, and the separating fluid abundant. The softened tissue has the tint of the normal cerebral substance. The process is the result of the imbibition of fluid from some collection of serum, in the ventricles or elsewhere, and occurs in the greatest degree in the immediate vicinity of this. In ante-mortem softening there are, in addition, certain changes in the tissue-elements. The process of segmentation of myelin results in the formation of finer granules. These are in part aggregated into 'granule-corpuscles,' round or oval masses of globules and granules, sometimes contained within a distinct cell-wall. Some of these bodies may arise by simple aggregation, others by the degeneration of connective-tissue cells, and some by the aggregation of products of nerve-degeneration within cellular elements of various kinds. The walls of vessels in the softened area also present fatty degeneration. No further change may exist, and the area affected may present simply a diminution of consistence, its colour remaining unchanged. It is then called *white* or *grey softening*. Very frequently, however, in the part thus diseased, distension of capillaries with blood occurs, most considerable in the periphery, and blood is actually effused, chiefly by rupture of capillaries, in trifling degree perhaps by migration of corpuscles. In proportion to the amount of blood mingled with the softened brain-tissue, the colour of the affected area is changed, and thus *red softening* is produced when the amount of blood is considerable. In the change which results from closure of a vein, the tissue is crammed with punctiform extravasations, and a purplish colour results;

but, as already stated, there is not the general diminution of consistence that brings the alteration into the category of 'softenings.' After a time, the blood effused in red softening degenerates, its tint becomes altered to yellow or orange, and *yellow softening* is produced. Ultimately, it is said, the colour, if at first moderate, may be removed and white softening result, but the pigment that gives rise to the yellow tint may remain for many years.

Red softening is found chiefly in the grey substance, where the vessels are numerous, especially in the cortex and central ganglia. The tint varies; the red colour is usually punctiform, or mingled with yellow and white. If the extravasations are large and numerous, 'capillary apoplexy' results. According to the amount of effusion of serum and blood there is swelling, and the diseased area may project above the cut surface. Inflammatory changes result from the vascular distension, and in proportion to these, increase in the nuclei of the neuroglia is found, especially at the circumferential portions. From this cause, and from the migration of white corpuscles, pus-like cells appear among the products of degeneration in varying quantity. The vessels are dilated, and may present a moniliform appearance. Their perivascular sheaths are often distended with blood.

Yellow softening results from red softening, by degenerative changes in the blood effused attended with a change in its pigment. It has a similar seat, being frequently met with in the convolutions, where it constitutes the *plaques jaunes* of the French. Its consistence is usually slight, its aspect granular. The colour depends on the presence of minute pigment-granules, diffused colouring matter, and hæmatoidin crystals.

White softening has the tint of the normal cerebral substance. In consistence it varies: it may be only a little below that of the cerebral substance, or it may be diffluent. Its aspect is uniform, or white flakes are scattered through it. The limits are usually gradual. Under the microscope it presents the detritus of nerve-elements, a few nuclei from the connective tissue, granule-corpuscles, and, ultimately, corpora amylacea. White softening is chiefly found in the white substance of the hemispheres. It occasionally has a gangrenous odour, and then may be found in the white or in the grey substance; probably this form results from the obstruction of capillaries by septic material. It is theoretically probable that when softening is white from the first, the capillaries are the seat of the primary obstruction. It occurs also in the zone of cerebral tissue in which meet the regions supplied by the arteries of the cortex and of the central ganglia.

Ultimate changes.—White and yellow softening may remain for years unchanged. Usually the products of disintegration of the nerve-elements are gradually removed, so that a cavity remains, across which bands and trabeculæ pass—the remains of vessels and other structures that have escaped total necrosis. Sometimes the changes in the elements of the neuroglia and the extravasated white corpuscles, &c., result in the formation of a considerable quantity of connective tissue, consisting of fine fibre-cells and fibres, most abundant in the margins of the softened area, which become firm and dense, whilst the trabeculæ of the connective tissue, crossing the cavity, are thickened in like manner. After a time, when the amount of this tissue is considerable, the fluid may be absorbed, and a sort of cicatrix result from the union, partial or complete, of the walls. In other cases the walls alone are thus altered, the solid particles are removed from the softened tissue, and a cyst is formed. The outer portion of the cyst or cicatrix may be limited by a zone of dilated blood-vessels, presenting, under the microscope, a peculiar and quite characteristic feature.

Seats of softening.—There is no part of the brain in which softening has not been found, but its most frequent seats are the cortex, the corpus striatum, and the optic thalamus. In the pons Varolii and medulla it is also frequently found, but it is rare in the cerebellum. Its frequency in the medulla is underrated because only minute areas of softening are compatible with a duration of life sufficient to permit them to assume a characteristic aspect. Its occurrence, position, and characters depend on the distribution of the vessels. The small arteries of the corpus striatum and optic thalamus are 'terminal arteries,' having only capillary communication with other vessels, insufficient for a collateral circulation adequate to maintain the vitality of the tissue. The arteries to the cortex of the brain are sometimes terminal, but sometimes possess anastomoses by arterioles with other branches. Hence obstruction in the central arteries leads invariably to softening, while obstruction in the superficial arteries may also cause softening (which involves the grey substance of the convolutions and some of the subjacent white centre to which the vessels penetrate), but often the anastomoses of the superficial vessels are so free that softening does not result. An obstruction of a main trunk (as the middle cerebral) may lead to softening of the central region (corpus striatum), while the convolutions escape; but usually both suffer. For the same reason, the softening of the cortex is apt to be irregular in distribution, and partial even within the region of the obstructed artery, a feature considered further in the article on Diseases of the Vessels of the Brain.

Symptoms.—The *premonitory* symptoms of softening of the brain depend upon its mechanism, and are considered in greater detail in the articles describing its causes. In embolism other symptoms than those of cardiac disease are usually absent. Occasionally a slight attack of loss of cerebral function, due to a slight embolism, may precede a graver attack. In softening due to arterial disease, premonitory symptoms of local cerebral anæmia are frequently present; these may exist for months before the onset, or only for a few days, or even for a few hours. There is also, in many cases, sufficient disease to impair the nutrition of many parts of the brain, revealed by symptoms of wide range—mental deterioration, numbness, and pains in the limbs, pain in the head, or slight local weakness. These symptoms are of especial significance when associated with evidence of degeneration elsewhere in the arteries; with the conditions—as chronic Bright's disease, alcoholism, and senility—in which atheroma of the cerebral arteries is common; or with constitutional syphilis.

The symptoms of *actual* softening are those of loss of function in the damaged portion of the brain. Strictly, indeed, these symptoms are those of the anæmia that causes the softening, and which, depriving the brain-tissue of the material for its functional action, arrests the latter with a rapidity which seems to suggest that other influences may co-operate in the arrest. The onset of the symptoms may be actually sudden, as in embolism, and sometimes in thrombosis; or it may be gradual, as occasionally in thrombosis. In the former case, the symptoms of initial shock are added to those due to the structures involved (*see* Convolutions of the Brain and Cortex Cerebri, Lesions of; &c.). Hemiplegic symptoms and mental disorder are the most common. Hemiplegia especially occurs in embolism, on account of the frequency with which the middle cerebral artery is obstructed, and of the important motor regions (corpus striatum and motor parts of the convolutions) to which that artery is distributed. From the distribution of the artery to the lower frontal convolutions and adjacent region, aphasia is frequently present when the obstruction is on the left side.

When the symptoms come on suddenly, they often occur after some fatiguing exertion, or during exhaustion from any cause. If the area damaged be extensive, there is loss of consciousness, and there may be all the symptoms of an apoplectic seizure. The loss of consciousness is rarely profound, and the symptoms of apoplexy soon pass off. In the most severe cases, however, they may deepen to fatal coma, especially when an important artery is occluded in each hemisphere. Thus the closure of both middle cerebrals causes symptoms indistinguishable from those of ventricular hæmorrhage and equally fatal in ultimate result. Symptoms of irritation commonly succeed those of apoplexy as the collateral hyperæmia sets in, or they may be marked at the onset. Convulsions, often unilateral, may occur and be repeated for days, chiefly when the softening involves the motor region of the cortex, and spares the path from it through the central ganglia. The patient may pass from the apoplectic condition into one of delirium. In the old, delirium may be the chief symptom of the onset in cases in which the softened areas are small, multiple, and cortical in situation. According as these symptoms are chiefly marked at the onset three varieties have been described, the *apoplectic*, *convulsive*, and *delirious* forms.

Recovery from the special symptoms of the attack is often incomplete; permanent weakness may remain, as hemiplegia, and mental power is weakened, the patient passing into the chronic state about to be described. The persistent hemiplegia is often accompanied by rigidity, or, when the loss of power is incomplete, by mobile spasm, such as, in its most marked form, has been described as *athetosis*. When the cause is arterial degeneration, return or relapse is common, and it is almost invariable where senile arterial disease is widely spread.

Chronic softening of the brain is a term applied to a group of symptoms, of wide range, indicative of failure of cerebral power. It is a term that has become firmly rooted in popular nosology, where it denotes chiefly general paralysis of the insane, but includes also all maladies attended by a similar mental failure, profound in degree and permanent in duration and progressive in course. This use of the word is a source of considerable inconvenience, since it may be strictly accurate to deny the application of a name to that which, nevertheless, it perfectly connotes; and it is generally wiser to explain the change which has come over the use of the word, rather than to give a simple answer to the question in the form it commonly assumes, Is it softening of the brain? The symptoms indicated by the term may supervene on more acute symptoms of softening, or may be gradual in their onset. There is mental dulness, defective perception, drowsiness, loss of memory (especially for recent events), often slight wandering; emotional manifestations are easily excited. Physical power is defective—as a rule generally, sometimes locally. The more delicate motor actions are imperfectly adjusted: articulation becomes indistinct, and the handwriting imperfect. These symptoms may progress into actual imbecility, or may be cut short by some more profound cerebral seizure, or by some intercurrent pulmonary affection, rendered grave by the deficient muscular respiratory power. They are met with chiefly in the old, and are probably due to concomitant degeneration of cerebral tissue and of the arteries supplying it with blood—the two pathological elements varying in relative degree and in relation. Spots of softening, often widely spread, may be found, and are, indeed, the cause of many of the symptoms. But the state may also come on without any local softening, and without the degenerated vessels to which such softening is usually due. A similar state often follows any grave local lesion of the brain in advancing life.

Progressive symptoms, focal or general, or both, sometimes of the character just described, and sometimes such as are caused by a cerebral tumour, have been met with in a few cases in which extensive local softening of the cerebral tissue has been found, without vascular disease to explain it, and without correspondence with arterial territories. Most subjects have been old, and the disease has not commonly been diagnosed during life. Recorded cases are at present too few to permit an adequate history of the disease to be inferred. Altogether, not only is the term one of loose usage, but the lesion is one of such varied relations, and its symptoms of such equivocal significance, that the subject is a region of cerebral pathology in which very much remains to be done to establish even a firm outline of scientific knowledge.

Diagnosis.—The *acute* form of softening has to be distinguished from acute congestive apoplexy and from cerebral hæmorrhage. It is distinguished from the former by the occurrence of the symptoms indicative of local mischief, and by the absence of evidence of cephalic hyperæmia. From hæmorrhage the diagnosis is often difficult, except during the first half of life, when hæmorrhage is so rare that it should only be thought of when loss of consciousness is profound and prolonged. In softening from thrombosis, the initial apoplectic symptoms may be absent, or, if present, slight and brief. They are more often preceded by slight local cerebral symptoms, due to the vascular disease, than is the onset of cerebral hæmorrhage. In the latter such symptoms are merely associated, and are not due to the cause of the hæmorrhage, except in the rare cases in which there is an aneurysm of one of the larger intracranial arteries. In these, however, preceding arterial symptoms are often more considerable in degree and duration than those which precede softening. Most important is the indication afforded by the state of the heart; evidence of its hypertrophy is seldom absent in cerebral hæmorrhage, while it is feeble and often irregular in the softening from atheroma, and presents evidence of valvular disease in embolism. Improvement occurs earlier than in cerebral hæmorrhage. The temperature rises soon after the attack, but falls in a day or two; in hæmorrhage the rise occurs later (Bourneville). There is more marked mental change than in hæmorrhage, shown at first in excitement, subsequently by depression and deterioration of power. In the cases in which the onset is sudden and the apoplexy profound, a diagnosis from hæmorrhage is often impossible. In embolism the onset of the attack is commonly sudden, but the loss of consciousness is less profound than in hæmorrhage, and is often absent. This is true also of softening from syphilitic disease, in which the diagnosis is often aided by a history of the causal malady. Too much weight must not be laid on the absence of such a history in patients in whom the disease is possible, and especially little significance can be attached to the absence of a history of constitutional symptoms, while neither the thoroughness of former treatment, nor a considerable period of freedom from symptoms, has any value whatever as a contra-indication. But with the lapse of time, it does become unlikely that softening is due to this cause; still, it is only after twenty years, and in the absence of any suspicion of a second infection, that the improbability has considerable weight. Optic neuritis, developing after the lesion, occurs in rare cases of softening from embolism, and is practically absent in hæmorrhage. In all cases the various indications must be compared and balanced, and their relative weight noted in the estimation, special caution being taken to allow no weight to negative facts in the presence of positive evidence of opposite significance. In capillary embolism, if extensive, a distinction from hæmorrhage often cannot be made—the loss of consciousness is profound and lasting. Bilateral softening, such as sometimes results from disease of both middle cerebral arteries, may also (as already mentioned) cause symptoms indistinguishable from those of ventricular hæmorrhage.

The distinction of softening from other cerebral diseases is described in the accounts of these.

Prognosis.—The immediate and ultimate prognosis in an attack of softening of the brain depends on the degree and extent of the symptoms, as indicating the extent of the lesion; and on their character, as indicating the region of the brain damaged. Both the near and the remote prognosis is much graver in damage to the medulla and pons Varolii than when the corpus striatum or cerebral hemispheres are affected. Locality is of especial importance in regard to the prognosis in softening, because it is by far the most frequent lesion of the medulla or pons that is survived. Hence the prognosis is of high practical importance at the onset as well as later on. The intensity of the coma indicates a greater degree of gravity than does its duration. Youth and general health favour the rapidity and the degree of recovery. Where actual softening has occurred, the damaged tissue never regains its functional power. The congested periphery may recover in proportion to the integrity of the tissues, and to the freedom of the vessels from disease. The chances of a recurrence of softening in another situation depend on the extent to which its causal condition is widely spread or can be removed. In vascular degeneration recurrence is almost certain. In embolism it is rare. The prognosis in syphilitic disease of the vessels depends upon the recognition and treatment of the syphilitic influence so far as recurrence is concerned; but the prognosis of developed symptoms is independent of the fact of this syphilitic cause, or of any treatment to which the patient may be subjected. Treatment can only influence the disease of the wall of the vessel, and this can have no effect in restoring the circulation, since the vessel beyond is closed by clot, or in restoring the structure of the destroyed tissue of the brain. As a matter of fact, the course of hemiplegia due to this cause is precisely the same as that of hemiplegia due to softening produced by any other vascular mechanism; improvement or recovery is determined by the position of the lesion, and the extent to which the symptoms are not due to the actual destructive softening, and to which they can be compensated. Improvement or persistence of symptoms may coincide with treatment, but the one is not due to it, nor the other the result of its absence.

Treatment.—The treatment at the onset of cerebral softening is of great importance, because, although nothing can probably be done to undo the mischief that has occurred, much may be done to prevent its extension or increase, and in many cases it is by such preventable extension or increase, after the patient comes under treatment, that the degree of ultimate disability, or death itself, is determined. It is essential that the attention of the practitioner should be fixed on the pathological process and its mechanism; he should endeavour to picture to himself clearly what is taking place and how it is being brought about, and arrange his therapeutic measures so as to counteract the morbid influences in the utmost practicable degree. The closure of a vessel by clot is the great fact of what may be termed the therapeutic pathology of these cases, and the measures to obviate the increase in this process have much in common in the various forms of softening. The variations rendered necessary by the differences in mechanism are considered in the articles on the several vascular diseases. During the acute stage the patient must be kept at perfect rest, with the head moderately raised, flexion of the neck being avoided. During the initial stage of shock, warmth by hot-water bottles, &c., should be applied to the extremities, to equalise the circulation. The bowels, if confined, should be made to act gently; but, unless the evidence of encephalic congestion be early and conspicuous, purgation should be avoided. The determination of blood from the brain to the intestines, involved in purgation, and desirable in cerebral hæmorrhage, is to be carefully avoided in cerebral softening. It is important also to maintain the circulation steady and uniform, avoiding alike undue quickening or slowing of the blood-current. Hence, digitalis is useful in all cases in which there is cardiac weakness or irregularity. In all senile cases, or when there is a gouty diathesis, nitrous ether or other diuretic drug is useful, and, in the latter case, some lithia may be added. Thus the tendency of the blood to clot is lessened, and the risk of the extension of the lesion—always a danger in the early stage of the affection—is lessened or obviated. Stimulants must be given or withheld according to the state of the heart and circulation; when there is doubt whether they should be given or not, it is better to give a small quantity in softening, and to withhold them in hæmorrhage or if the diagnosis from hæmorrhage is doubtful. After the stage of depression has passed, the irritation due to secondary inflammation, indicated by headache and elevation of temperature, needs quietude, laxatives, and sometimes cold to the head. When convulsions are an early and recurrent symptom, mustard plasters to the neck and extremities, and bromide of potassium, are sometimes effective; in the early period, cold to the head may arrest them. The fits that attend the actual onset are seldom influenced by treatment; they cease because the tissue is destroyed that is essential for their occurrence. When these fail, hyoscine may be given cautiously, and in small doses ($\frac{1}{500}$ gr.).

After the attack has passed, recovery must be aided by maintaining the general health in the best possible condition. The secretions should be kept free, the digestive organs in good order, the habits strictly regulated, and nervine tonics—cod-liver oil, hypophosphite of sodium, strychnine, quinine, and iron—may be given with advantage. The symptoms of chronic softening, whether occurring after an acute attack or coming on gradually, should be treated in a similar manner.

W. R. Gowers.

BRAIN, Syphilitic Disease of. *See* Brain, Tumours and New Growths of.

BRAIN, Tubercle of. *See* Brain, Tumours and New Growths of.

BRAIN, Tumours and New Growths of.—The intimate connexion of the brain with its membranes makes it impossible, except in the most general terms, to draw any marked distinction between tumours of the cerebral substance and tumours arising from its envelopes. A growth pressing inwards from a membrane must impinge upon brain-tissue; a growth originating in brain-tissue must in many situations involve the membranes.

Anatomical Characters.—The tissues from which tumours have their origin seem to present the best ground for a scientific classification of these lesions; and it is not devoid of interest to mark that the absolute nerve-elements of the brain are never primarily the source of a morbid growth.

Cerebral tumours, then, may be roughly separated into three series:—

1. Those whose centre of origin is some one or other of the membranes, external to the brain, or dipping into the ventricles.

2. Those which spring from the blood-vessels.

3. Those which own the neuroglia as their starting-point.

Dr. Gowers considers such a classification of small practical value, and believes it is more convenient to describe the various growths in the order of their frequency. Tumours, therefore, may be grouped in six categories:—

(1) *Diathetic:* Tubercular and Syphilitic. (2) *Sarcomatous:* Glioma, Sarcoma, Myxoma. (3) *Carcinoma.* (4) *Osteo-fibroid:* Fibroma, Osteoma, Osteo-fibroma. (5) *Miscellaneous:* Cholesteatoma, Lipoma, Vascular or Erectile Tumours, Psammoma, Neuroma. (6) *Parasitic:* Echinococcus and Cysticercus.

Taking, however, this original subdivision, which is Rindfleisch's, the tumours which are placed in each series differ somewhat from his arrangement. In the first series five kinds of tumour are found, arising from the membranes or from the free surface of the ventricles. These are Pacchionian granulations; spindle-celled sarcoma; myxoma of the membranes; psammoma; and lipoma. The second series will include, first, aneurysms, depending upon disease of one or more of the arterial coats; and, secondly, such tumours as have their origin in the sheaths of the vessels, comprising carcinoma cerebri simplex; fungus of the dura mater; cholesteatoma; epithelioma myxomatodes psammosum; papilloma of the pia mater and vessels; papilloma myxomatodes; and tubercle. In the third series may be counted glioma; myxoma of the nerve-substance; syphilitic gumma; and fibroma. Included under none of those headings, echinococci and cysticerci cellulosæ must be mentioned, as they affect the brain.

Each of the growths enumerated will now be briefly described.

1. *Pacchionian granulations.*—These are granulations of the arachnoid, sometimes met with in childhood, very constantly from middle age onwards, and scarcely recognised as morbid lesions. Their ætiology is unknown. They do not give rise to any symptoms. They are chiefly situated along the superior longitudinal sinus, which in rare cases is perforated by them. They form groups of papillæ, consisting of striped connective tissue, poor in cells, and proceeding directly from a thin but a continually renewed layer of sub-epithelial germinal tissue.

2. *Sarcoma.*—This sometimes has its origin in the nervous tissue itself, but more frequently arises from the dura mater, especially at the base of the skull. From their situation sarcomata are especially apt to interfere with one or more of the cerebral nerves. They may attain the size of a pigeon's or even of a hen's egg.

When sarcoma attacks the dura mater it originates from its internal side. The most usual situation is the membrane about the sella turcica and the pars petrosa. It forms a depression in the brain, while the bone becomes atrophied behind it. The growth is composed of fusiform cells, with tolerably numerous and sometimes dilated vessels. Sarcomatous growths are not freely developed above the surface, but rather in the depths of the tissue; they distend the cerebral convolutions, form deep depressions on the surface, and even penetrate far into the brain. They occur under two forms—*hard sarcoma* with compact fibrous fundamental tissue and small cells, often called fibrous tumour; and *soft sarcoma*, with a loose scanty intercellular substance, and numerous cells of comparatively large size. The cells are mostly fusiform, but sometimes round and multinuclear, and the two latter may be surrounded by the former. Sarcoma in this situation is generally single. It may attain the size of a nut or even of an apple, and is frequently hæmorrhagic.

In the cerebral tissue itself the hard sarcoma attains a great degree of density: it is sometimes fibrous, at other times cartilaginous, of a dense homogeneous structure, whitish or bluish-white, with a yellow tinge here and there, and with very few vessels. It is distinguished from the brain that surrounds it by a very vascular zone. It can be easily separated from the parenchyma, and may thus be recognised after death from simple sclerosis and hard glioma of the brain. The softer form—fibro-cellular sarcoma—is generally either a myxo- or a glio-sarcoma: but pure fuso-cellular sarcoma is met with. The tumour is a clear grey, almost like the grey matter of the corpus striatum. It is often vascular, with a reddish tinge. These sarcomata are often almost spherical, and easily detached from the surrounding brain-substance. Others, however, seem to be continuous with the neighbouring substance, and to be little more than simple hypertrophies of the cerebral tissue. Especially is this the case in tumours of the corpus striatum and optic thalamus. The cells of cerebral sarcoma are frequently the seat of fatty degeneration, and the whole tumour may be hæmorrhagic. Its most frequent situations in the brain are the ganglia at the base.

3. *Myxoma.*—Myxoma of the membranes is rare, and generally has its origin from the convexity of the brain, being connected with the inner surface of the dura mater. It is a small growth, soft, fragile, having a gelatinous aspect.

Myxomata are frequently met with in the cerebral hemispheres, and then take their origin from the neuroglia. Such growths are probably malignant, the proofs of their malignancy being that they are often multiple locally; that they frequently recur when removed from a peripheral nerve; and that they not seldom affect internal organs. Myxoma possibly includes all that has been called colloid cancer. When this lesiòn affects the cerebral hemispheres it may be of large size. The mucus is a constituent part of the tissue; it is not a product of secretion, as in mucous cysts. It is most commonly a mucoid form of glioma.

4. *Psammoma.*—Psammomata have been met with in the brain, spinal membranes, spinal cord, and nerves; they are not uncommon in the choroid plexus, but are most usually found in the pineal gland. There are two kinds of these growths. In the first, the sand occupies the interior of the meshes of the connective tissue in very varied forms, as compact cylinders, as pear-shaped masses, as spines, or as globes, surrounded by connective tissue, and connected by it with the other parts of the tumour. In the second form, the sand lies without cohesion in the parts and between them, so that the different grains of sand may be easily isolated. In this latter form, the psammoma is composed most generally of round elliptical corpuscles, and sometimes also of large complex conglomerations. These little tumours have usually a concentric arrangement internally.

5. *Lipoma.*—This is a rare tumour in the brain. It may be connected with the inner surface of the dura mater, or with the ependyma of the ventricles. The fatty matter is contained in cells, and the cells are surrounded by an organised membrane. Lipoma is usually single, seldom multiple; of irregular shape; and varies in size from a small nut to a hen's egg. Small pieces of carbonate of lime have been found in these tumours.

6. *Aneurysms.*—The larger cerebral aneurysms have been observed from early times. More recently Liouville has called special attention to the subject of miliary aneurysms, and has shown that they are common; that they are multiple; that they frequently give way in the brain or in the pia mater; and that they often co-exist with aneurysms of the larger vessels in other parts of the body. Aneurysm of the middle meningeal, of the internal carotid within the cavernous sinus and at its exit from it, of the anterior cerebral, of the anterior communicating, of the arteries of the corpus callosum, of the middle cerebral, of the posterior communicating, of the vertebral, of the basilar, of the posterior cerebral, and of the arteries supplying the cerebellum, are all met with not infrequently. The middle cerebral and the basilar, however, are the vessels most usually affected with this lesion.

The minute miliary aneurysms have been observed in the pia mater, at the surface of the convolutions or in their substance, in the optic thalami, the pons, the corpora striata, cerebellum, crura cerebri, and medulla oblongata; more rarely in the centrum ovale. A large one was found by Dr. Bastian in the lenticular nucleus. These miliary aneurysms may be visible to the naked eye. The smallest are seen under the microscope as ampullæ of the vessels, containing coagulated blood or granules of hæmatoidin. The arterial walls have generally undergone some form of degeneration. The vessel, dilated at some parts, is constricted at others. The lesion may be a consequence of atheroma of the vessel, but far more commonly it is the result of arterio-sclerosis of the inner coat of the vessels, either at the seat or in the immediate neighbourhood of the aneurysm. Embolism is a frequent cause. *See* BRAIN, Vessels of, Diseases of.

7. *Carcinoma cerebri simplex.*—Cancer, excluding from this term sarcoma and glioma, may originate in the cranial bones, the dura mater, the pia mater, the cerebrum, the cerebellum, the pons, and the medulla oblongata. The medulla oblongata, the fornix, and the corpora quadrigemina are the regions least often affected, whereas the cerebral hemispheres are the most favourite localities. All forms of cancer are met with, in all cases having their origin in the coats of the vessels. Epithelial cancer has been generally believed to have its starting point in the peripheral layer of the arachnoid, the tissue that lines the under surface of the dura mater. Encephaloid cancer is, however, the most common form met with in the brain.

8. *Fungus of the dura mater* can scarcely be separated from the preceding form. It arises from the outer surface of the dura mater, penetrates with the vessel from which it springs into the compact tissue, destroys the vitreous table, and spreads out in the diploë: in its progress it may penetrate the external table and lift up the integuments of the cranium. The internal table invariably suffers more than the external. Sometimes there is coincident passage of the tumour inwards, and the subjacent membranes become glued to the dura mater and to the cerebral substance. There may result simply the depression of surface consequent upon pressure from above, but more commonly cell-growth similar to that of the original tumour takes place, first from the vessels of the pia mater, and afterwards from the vessels of the cerebral convolutions.

9. Closely allied to the epithelial cancer that has its origin in the dura mater is the *cholesteatoma*, which is generally situated at the base of the brain. Rindfleisch considers it a squamous epithelioma, whose cellular cylinders are wholly converted into a mass of pearly nodules with a silky lustre. It is

covered by the arachnoid, and springs either from the vessels of the pia mater, or more rarely from the perivascular sheath of the vessels in the substance of the brain.

10. Last of the cancers is a tumour that has been found in the third ventricle—*epithelioma myxomatodes psammosum*—consisting of globes and cylinders of epithelial cells, embedded in a very bulky stroma of mucous tissue.

11. Springing also from the vessels, two forms of *papilloma* are met with—papilloma of the pia mater and vessels; and papilloma myxomatodes. The former is composed of a number of branching papillæ, each of which contains a blood-vessel with a small amount of connective tissue, and a double coat of epithelium, of which the outer layer is columnar. In the latter, which is probably a mere variety of the former, the structure of the tumour is the same, but the columnar cells secrete a vast amount of viscid mucus.

12. *Tubercle* springs from the middle tunic of the small arteries of the pia mater, or of the nerve-substance. It rarely attacks the membranes in the form of tumour, rarely also the white matter of the brain, but prefers, as its principal seat, the grey matter of the convolutions and of the deeper parts. Tubercle of the dura mater is, however, sometimes met with, and it may induce obliteration of sinuses. The cerebellum is a frequent seat of tubercle, which exists here in the form of superficial granulations. The pons also is frequently affected with tubercle, both in the form of small tumours of its substance, and as polypous tubercles of the fourth ventricle. Tubercle is separated from the surrounding cerebral substance by a very delicate reddish envelope.

Tubercular tumours of the cerebral substance are often multiple, and not infrequently large; they are of very slow growth; persist long in the caseous state; and may be found cretified. Sometimes there is cerebral softening around them. Virchow states that the increase of tubercles takes place by apposition or juxtaposition, and that the apposition takes place not by layers primarily caseous, but by zones of new grey proliferation, usually in the form of miliary tubercle. A very delicate layer of connective tissue of new formation, a species of encysting false membrane, represents the mother-tissue for the subsequent generation of young tubercles.

13. *Glioma*, called by Billroth *granulated sarcoma*, or *round-celled sarcoma*, is practically a local hyperplasic development of the neuroglia. It may appear in three forms, either as *soft glioma*, rich in cells—the most common kind; as *hard glioma*, fibrous, and, if the vessels are much developed, telangiectasic; or thirdly, as a *myxoglioma*, a complex tumour, in which part of the tumour takes the appearance of mucous tissue. The nature of the tumour is partly determined by the nature of the tissue from which it springs; thus glioma of the brain is generally, but not always, soft, glioma of the ependyma hard. The soft gliomata are closely allied to myxomata. The intercellular substance is found in moderate quantity. In the more mucous gliomata the network is regular and large, and the tissue has little cohesion. If the meshes are larger still, and the mucous element abundant, this variety passes into a myxoma. If there be a considerable increase of cells, whilst the trabeculæ become narrower, we get a medullary glioma, which may be transformed into a medullary sarcoma if the cells continue to grow and multiply. These transitions are not uncommon even in the same tumour, especially in the posterior lobes of the brain. If the vessels are developed in great abundance we get hæmorrhages and a kind of fungus hæmatodes. Hard glioma is closely allied to fibroma, with which indeed it may be combined to form a fibro-glioma. In hard glioma the fibres are not arranged in a network, but in parallel lines, like felt. The nervous elements, naturally contained in the neuroglia, are absent in these tumours. The walls of the vessels are frequently thickened.

The glioma of the ependyma is of little importance; it is seen as fine granulations on the surface of the lateral ventricles in chronic hydrocephalus; on the floor of the fourth ventricle it may grow to the size of a cherry. In the cerebral substance, gliomata may attain the size of a fist, or even of a child's head; and they are often mistaken for cancers or sarcomata of the brain. Hard glioma may be distinguished from sclerosis, in that sclerosis encloses the normal nerve-elements. In glioma, too, there is great proliferation of neuroglia cells. There is no distinct limit between glioma and the surrounding brain-substance, but the tumour on section shows greater vascularity, greater consistence, and a more transparent constitution, as well as often a bluish-white appearance compared with the white brain-matter. The demarcation in grey matter is imperceptible to the naked eye, especially if the glioma be soft. Soft glioma is generally single; hard is often multiple. The membranes may adhere, but form no part of the tumour.

Virchow thinks that glioma is not malignant; that hard glioma has an inflammatory origin; and that the soft variety is set up by local causes, such as injury. Gintrac, on the other hand, unites gliomata and sarcomata under the head of cancers.

Soft glioma is most frequently situated in the posterior lobes, less often in the upper and lateral parts of the cerebral hemispheres. It may be congenital. It gives rise to complications — namely, first, great congestion, causing cerebral compression, irritation, pain, excitement, or apoplexy; and, secondly, hydrocephalus of the ventricles, which in protracted cases is seldom absent. The latter occurs most rapidly in glioma of the optic thalami, or of the posterior lobe, compressing the choroid veins, the venæ Galeni, or the transverse sinus.

14. *Myxoma of the nerve-substance.*—This is not common in the brain. It owns the same origin as glioma, having the neuroglia as its starting-point.

15. *Syphilitic gumma.*—Gummy tumours of the brain are generally found at the circumference, and especially at the base of the brain. Their origin is either from the membranes, from the vessels, or from the neuroglia of the cerebral substance. They have infective properties, or at any rate they are multiple, and may be met with at the same time affecting the dura mater, the pia mater, the brain, nerves, and cranial bones. They are often accompanied by inflammatory phenomena, a point which distinguishes them from large tubercles. Gumma is not the usual form in which syphilis attacks the dura mater on its external surface. It may, however, affect the arachnoid surface of the dura mater. In this situation the gummata may vary in size from a hemp-seed to a nut. They may be found just above the convexity of the hemispheres, or at the anterior part of the base of the brain, especially about the sella turcica, or on the tentorium cerebelli. They have been met with in the falx cerebri. The inflammatory condition around these tumours often unites them to the pia mater, and the subjacent portion of brain is frequently softened, either by the inflammation, or by arterial obliteration.

When the pia mater is united to the dura mater, gummata very small in size may form in the former membrane. The subjacent brain may be softened or sclerosed. Much larger gummata, however—from the size of a nut to that of a hen's egg—originate from the pia mater, and are most usually situated in the region between the optic chiasma and the pons, or on the crura cerebelli. On the convex surface they are much smaller. Gummata of the cerebral substance occur in situations most subject to traumatic influences. The chief seats are the cerebral hemispheres, the large ganglia, especially the optic thalami, and next in frequency the pons, and crura cerebri and cerebelli. The tumours attain to a good size, but are not so large as those of the pia mater. They may be multiple, but often exist singly. *See* BRAIN, Vessels of, Diseases of.

16. *Fibroma.*— True fibromata, distinct from hard gliomata and sarcomata, probably do not exist in the brain or its membranes. Fibromata are essentially composed of connective tissue. Such increase in this tissue is sclerosis, and its arrangement is too indefinite, its amount too small, to be considered a tumour. Rindfleisch is probably wrong in stating that there are solitary tubercles of the brain which deserve rather to be called fibroid tumours; although it may be true that in some cheesy nodules of the nervous centres the growth of fibres and the condensation predominate enormously over the corpuscular structure. Practically, however, both *enchondromata* and *osteomata* are fibrous tumours. An enchondroma is a heterologous tumour not developed from a pre-existing cartilage, but produced by a change in the type of formation by proceeding from a non-cartilaginous matrix. Although osteoid enchondromata may be malignant, yet true osteomata are not so. These tumours may attack the cerebral dura mater, and on the convexity are multiple. If the tumour attack the falx cerebri it is solitary. Its starting-point is the internal surface of the dura mater. It is distinguished from exostosis of bone by having a fibrous layer between it and the bone. It may set up irritative pachymeningitis. Such tumours are also found small in connexion with the cerebral arachnoid, as simple united patches or pointed prolongations. Their favourite seat is the convex surface of the anterior lobes. The nervous centres are very rarely the seat of these tumours. Their matrix is formed by connective tissue, not cartilage, the product of irritation of the neuroglia, and so a consequence of circumscribed encephalitis.

17. *Hydatids* are rare within the skull, but are met with occasionally in all parts of the brain, between the membranes, in the ventricles, and lying free at the base of the brain. They are more common in children than in adults. The brain may suffer from pressure either in the way of softening from interference with the vessels, or from sclerosis.

Cysticerci are also met with in various parts of the brain or its membranes. They may be surrounded by connective-tissue capsules; or may lie free, arranged in a racemose form. They may be single, or may attack the same individual in several hundred places at once.

SYMPTOMS.—Even in tumours of considerable size all symptoms may be latent. The more tolerant portion of the brain will include the hemispheres and the white commissural regions, whilst the mesocephale, the optic thalami, and the corpora striata are amongst the least tolerant portions. It is not unusual, moreover, to meet with decided intermissions, especially in the early period of the disease; such intermissions depending on temporary lesions in the immediate neighbourhood of the tumour.

Even with these intermissions the diagnosis of the presence or position of the cerebral tumours would be comparatively easy, if the symptoms invariably depended upon direct excitation. Many of the phenomena pass the limits of the immediate sphere of the tumour, and are the results of reflex action.

Sometimes also the symptoms due to direct and reflex excitation may coincide, and this is particularly the case in tumours of the base. The main difficulties lie in the possible latency of all symptoms; in their intermission; in the distinction and combination of direct and reflex excitation; and in the remissions following physical or psychical excitement.

Symptoms, then, may depend on direct or reflex excitation, and consist of exaltation of functional activity, such as contractions, partial or general convulsions, hyperæsthesia, and hyperideation. Others are produced by secondary lesions in the neighbourhood of the tumour — congestion, hæmorrhage, inflammation, &c.—and these may include not only all in the previous division, but temporary or persistent paralysis, fever, and other phenomena. Then there may be symptoms of direct compression, definite paralyses, and gradual enfeeblement of the sensorial and intellectual faculties.

Taking some of the more common conditions in order, and viewing them as dependent on direct or reflex irritation, the most frequent certainly is headache; and except in tumour of the cerebellum, when the headache is almost invariably occipital, there is no symptom less useful in determining the position of the lesion. It is less frequently due to direct excitation than to reflex. The pain is very severe, indeed, more so than in any other disease, excepting, perhaps, meningitis; it persists through the whole malady; and is increased by vibration of all kinds, light, sound, or movement of the head. It may be confined to a single spot, or be diffused over the whole head. Connected with headache in many cases, and often equally the effects of radiated influence, are tinnitus aurium, morbid acuteness of hearing, or painful sensitiveness to sound; disturbances of vision, diplopia, muscæ volitantes, and strabismus, which may be transient; formication, and sometimes hyperæsthesiæ of greater or less extent. In some cases there is an agitated condition of the intellectual faculties, and even delirium. Disturbances of sight are very common. The retinal lesions will be subsequently described. It is a remarkable fact, as bearing upon the decussating arrangement of the optic nerves, that the affections of sight usually implicate both eyes, even where the tumour has involved only one optic nerve, and is not situated near the optic chiasma or the corpora quadrigemina. Hearing is far less often affected than vision. Generally a slight diminution only of this function is observed; and, in the rare cases in which complete deafness is met with, it is unilateral. Taste and smell are seldom interfered with. When these special senses are morbidly affected, the tumour will probably be situated in the uncus gyri hippocampi (the hippocampal lobule) or its immediate vicinity.

The symptoms of compression may be included in the expression 'lowering of function,' comprising apathy, feebleness of memory, want of attention, confusion, and a general enfeeblement of ideas. These conditions are often accompanied or preceded by certain diffused symptoms, such as vertigo.

Vertigo is the first symptom in many cases: it is felt especially when the patient is in the upright position. It often produces uncertainty of gait, even where the tumour is not in the cerebellum. Strange sensations in the head are also complained of, a feeling of liquid in the head, or of a mobile body; or the sensation may be that of a solid body filling the head, or pressing upon some portion of it.

These phenomena often coincide with evidences of irritation of the mesocephale, whether due to direct compression or to radiated irritation of the medulla oblongata. Chief amongst these symptoms is vomiting. It is not accompanied by nausea or other manifestations of dyspepsia, and it will occur when the stomach is empty. It can frequently be checked only by keeping the patient in a recumbent position. Constipation also is often obstinate.

Epileptiform convulsion has an important bearing on the diagnosis of these lesions. Very frequently convulsion is preceded by many of the phenomena already touched upon, such as headache or vertigo. Frequently, however, convulsion precedes all other morbid phenomena, and the patient may be in perfect health in the intervals of the attacks. Given, therefore, convulsion as the one factor in forming an opinion, it is necessary to consider the liability of the patient to convulsive attacks from causes other than tumours; to realise whether the family history shows any suspicion of epilepsy; and to eliminate from the case the possibility of saturnine, alcoholic, and uræmic poisoning. If this is done, and especially if we find early convulsion associated with headache and with vomiting, this symptom will prove an important aid in the diagnosis of tumour.

The phenomena depending on the presence of tumour itself may be associated with others due to complications, such as œdema, congestion, encephalitis, or meningitis of the surrounding parts. A high temperature, for instance, will point to inflammation either of the nervous substance or of the meninges near the lesion; and meningeal inflammation seems to be accompanied by the highest temperature. Syphilitic gumma, however, may coincide with syphilitic meningitis on some other portion of the encephalon not directly connected with the immediate surroundings of the tumour.

Passing for the moment the subject of definite paralyses with the remark that the sphincters are seldom affected, even in cases in which the paralysis takes a paraplegic form, it may be mentioned that a want of equilibrium seems to be a not unusual evidence of the presence of tumour in the cerebellum. Aphasia may not only be due to the special localisation of tumour in Broca's region of the left anterior lobe, but also to the presence of this lesion in any part of the tract (corpus striatum, optic thalamus, or crus cerebri) which unites this portion of the hemisphere to the medulla oblongata, the highway by which the centre for the production of articulate speech is connected with the co-ordinating centre for this function, or to tumour affecting those centres lesion of which is associated with word-blindness, or word-deafness. Anæsthesia of the skin is seldom met with as a symptom of cerebral tumour. When present it is found only in the limbs affected with motor paralysis, and is scarcely ever complete.

Symptoms of special localities.—It remains to take special regions of the encephalon separately, and to endeavour to differentiate the position of the tumour by the symptoms attending its presence.

Tumour in the *medulla oblongata* will be accompanied by various disturbances of sensibility, especially headache, and sometimes by convulsions. The pressure of a tumour is seldom limited to the medulla oblongata, and the symptoms therefore are complex. In several of the cases recorded there has not only been amaurosis and deafness of one side, but interference with taste and smell. Aneurysm of the basilar artery has been known to cause temporary albuminuria and convulsions coincident with each other.

Tumour of the *fourth ventricle* may manifest itself by the presence of sugar or inosite in the urine. Tumour here, as in the medulla oblongata, frequently destroys life quickly, before there has been time, so to speak, for much local lesion to be set up. Vomiting is a frequent symptom.

Tumour of the *crura cerebelli* and of the *corpora quadrigemina* cannot be diagnosed by any peculiar symptoms. In one case, in which the corpora quadrigemina seemed wholly transformed into a tuberculous mass, the sight remained good, but there was double ptosis.

In tumour of the *cerebellum* there is little disturbance of sensibility, except occipital headache. There are various disturbances of motility, especially convulsions and irregularity of locomotion, but no true paralysis. Amblyopia, amaurosis, and convergent strabismus are common. There is no interference with the psychical functions, or with speech, as a general rule. Vomiting is very common. In 76 cases collected by Ladame, there was no abnormality in the genital functions, except in 4 instances.

In tumours of the *pons*, the disturbances of sensibility are general or partial anæsthesia, and in some cases more or less headache. Hemiplegia, of unequal degree on the two sides, and other forms of paralysis are observed, but no convulsion. Various and manifold disturbances of the special senses; phenomena of depression of mind; frequent alteration of speech; and early disorders in swallowing, occur.

Tumours of the *crura cerebri* follow the example of the same lesion in the pons with reference to disturbances of sensibility. Equilateral hemiplegia opposite to the lesion is met with, and paralysis of the oculo-motor nerve on the same side as the tumour, often gradually extending itself to both oculo-motors.

Tumours of the *pituitary gland* are accompanied by intense frontal headache; by no definite disturbances of sensation or of motion; by double amblyopia or amaurosis, unequally developed; and by no loss of speech.

Tumours of the *middle cavities of the cranium* seem to affect mainly the third and the fifth nerves, anæsthesia or pains in the face and ptosis being the prominent symptoms, with some interference with the free action of the other muscles of the eyeball supplied by the third. In one case, in which a scirrhous tumour of the left side was situated on the inner surface of the sphenoid bone, extending laterally to the internal auditory meatus and backwards to the pons, not only were the third and fifth nerves paralysed, but colour-blindness supervened some time before death.

In tumours of the *corpora striata* and *optic thalami*, headache is less frequent than in other regions. Hemiplegia and convulsions are frequent, the former especially so. Hardly any disturbance of the special senses is observed. Intelligence and speech are frequently disordered.

In tumour of the *corpus callosum*, there is frequently some mental aberration, and often convulsions; but not rarely a total absence of morbid symptoms.

In tumour of the *middle cerebral lobes*, headache is frequently a prominent symptom, but otherwise the sensory disorder is mainly anæsthetic. Hemiplegia is common, as is also convulsion of an epileptiform character. These convulsive attacks are not rarely unilateral, and sometimes affect at first one limb only. In fact the position of a tumour towards the anterior portion of the middle lobe may be determined by symptoms with tolerable accuracy. Various disturbances of sight and of hearing are met with; as well as various psychical abnormalities, ranging from mere confusion of ideas to absolute imbecility.

In tumour of the *anterior lobes* there is general headache, seldom of the frontal region particularly. No other sensory disturbance occurs. Sight and smell are frequently affected, speech seldom. Hemiplegia, convulsions, and psychical disturbance will occur, much as in tumours of the middle lobes.

In tumour of the *posterior lobes*, there is general headache, seldom localised in the occiput; no other sensory disturbance. Slightly marked hemiplegia occurs, and convulsive attacks are very frequent. There is no disturbance of the organs of special sense. The mental faculties are greatly altered, particularly in the tendency to depression.

All three lobes may be affected with tumour coincidently, and the headache is then very intense; the epileptiform convulsions exceed the paralytic phenomena; the organs of special sense are little affected; and there are various mental disturbances.

In tumour of the *convexity*, the headache is generally limited either to the frontal regions, to one side of the head, or to the occiput. There is neither anæsthesia nor paralysis, but intense convulsions occur. The special senses are not disturbed. The mental condition is one of irritation, evidenced by delirium and excitement.

Lastly, very various regions of the brain may be simultaneously the seat of tumour, and the morbid phenomena will be necessarily complex.

Retinal changes.—It has seemed more convenient to speak of retinal changes dependent on cerebral tumour separate from the other symptoms. Great variations in the lesion occur—according to the position of the tumour; its direct interference with the optic centres; its complication with meningitis; and its pressure on the optic nerves and chiasma.

Taking choked disc, optic neuritis, and atrophy of the optic nerve as the three chief lesions, cerebral tumour may very frequently induce choked disc, by interfering with the venous ebb from the eye; optic neuritis, if meningitis is associated with the tumour; optic atrophy, by pressure of the tumour on the optic nerve, or by this pressure of the tumour or of hydrocephalus secondarily induced by it on the optic centres or tracts, or by softening around the tumour, such softening implicating the optic centres, or, lastly, by the propagation of sclerosis. Any tumour situated far back in the encephalon may interfere with the venous flow through the venæ Galeni, and so produce hydrocephalus of the ventricles, and the retinal effects of hydrocephalus.

There are no retinal changes from tumour in the corpus callosum, nor, as a rule, from tumour in the optic thalami. Tumours of the cerebral hemispheres all influence the optic nerve, if they interfere with the base of the brain.

Tumours of the cerebellum may cause pressure on the lateral sinuses, the straight sinus, the venæ Galeni, or the torcular Herophili: pressure in any of these situations may produce choked disc. Or the tumour may affect the corpora quadrigemina; or softening around it may spread to these organs, and atrophy of the optic nerve be the result. *A fortiori*, tumour of the corpora quadrigemina themselves will lead to atrophy of nerve.

Tumour of the crura cerebelli causes hydrocephalus, and its effects on the retina.

In a similar way tumours springing from the bone or the membranes at the base of the brain may produce choked disc or atrophy, according to the position of the pressure, optic neuritis by complications with meningitis, or neuro-retinitis by irritation of the connective elements of the nerves (*see* OPHTHALMOSCOPE IN MEDICINE). Hemianopsia bitemporalis fugax has been shown by Oppenheim to be a valuable diagnostic symptom of syphilitic disease in the base of the skull.

COURSE.—The clinical course of cerebral tumours is intermittent and paroxysmal. In many cases, such as those of glioma, it is very slow. Two groups of phenomena may complicate its ordinary course, namely, those associated with meningitis and apoplexy.

SYMPTOMS OF SPECIAL TUMOURS.—Aneurysmal tumours may sometimes be distinguished by the sense of throbbing in the head; by the patient being of adult age or young; by his being attacked in the midst of perfect health; by vomiting being rare, apoplexy frequent, paralysis of cranial nerves early and unilateral; and by absence of mental phenomena. Aneurysm situated in the cavernous sinus produces exophthalmos. *See* BRAIN, Vessels of, Diseases of.

The symptoms of echinococci differ very little from those of other slow tumours: headache, dizziness, vomiting, syncope, and epileptiform attacks are most frequent. Disturbances of the motor and sensory functions, and also of the mind itself, are sometimes met with, and vary according to the situation of the lesion. The prognosis is unfavourable; the diagnosis impossible, unless echinococci exist at the same time in the liver.

Cysticerci manifest their presence in the brain by epileptic attacks, which augment in number and severity; the health of the patient between the fits is at first good, then apathy and torpor supervene; hemiplegia is rare, and never early; cranial nerve paralyses are exceptional; the symptoms are diffuse and bilateral, owing to the position of the parasite in the grey convolutions, and in many spots at a time. The age of the patient is above forty. Perhaps there may be evidence of the presence of cysticerci elsewhere.

Syphilitic tumours coincide with actual or previous syphilis. The headache attending this form of tumour is generally intensified at night.

In tubercle of the brain there is often a tuberculous family history, or the presence of tubercle elsewhere in the body. It seldom compresses cranial nerves. Its clinical evolution is often by paroxysms, and grave cases are combined with tuberculous arachnitis and hydrocephalus of the ventricles. Tubercle in the cortical substance of the brain and cerebellum may, however, be attended by no special symptoms.

In cancer also there is frequently a family history of this malady; and the cancerous cachexia may be present. Cancer seldom exists elsewhere when it is cerebral. This growth is much less often accompanied by symptoms due to congestion and hæmorrhage than glioma or sarcoma, being less vascular.

Prognosis. — The prognosis of cerebral tumour is always bad, except in syphilitic gumma, and perhaps aneurysm.

Treatment.—In syphilitic gumma and in aneurysm large doses of iodide of potassium may be used with more or less success. This remedy is also useful in dispersing the results of the meningitis which so often accompanies tumour of the base. Beyond this there is little to be done, except in the endeavour to relieve pain and to support the strength of the patient. In a few instances cerebral tumours have been successfully removed by operation. E. Long Fox.

BRAIN, Ventricles of, Diseases of. *See* Ventricles of Brain, Diseases of.

BRAIN, Vessels of, Diseases of.

1. **Aneurysm.**—The larger arteries of the brain, and their minute branches in the cerebral substance, are both liable to aneurysmal dilatation.

(*a*) *Aneurysm of the larger cerebral arteries* is more common than that of vessels of a similar size elsewhere. The large vessels of the base, or their primary branches, may be affected. The basilar and middle cerebral arteries are those most frequently diseased, aneurysms of these two vessels constituting more than half the cases. Next in frequency is the internal carotid. The vertebral, anterior and posterior cerebrals, anterior and posterior communicating, and anterior cerebellar arteries are occasionally, but less frequently, affected. In one or two recorded cases the aneurysm has been situated in the interior of the pons Varolii or cerebellum. The disease is rather more frequent on the left side, but this is chiefly due to the greater proclivity of the left middle cerebral compared with the right, a fact which is explained by the ætiology. There may be more than one aneurysm, situated on different arteries, or on different branches of the same artery. The aneurysm is usually sacculated, rarely dissecting. Its size usually varies from that of a pea to that of a nut, but aneurysms have been met with as large as a hen's egg. When the size is considerable the brain-tissue is pressed upon and softened, as by any other kind of tumour.

Ætiology and Pathology.—These aneurysms are rather more common in men than in women, after actual childhood, and are far more frequent before the ordinary degenerative period than aneurysms elsewhere. Nearly half the recorded instances have occurred between ten and forty years of age, and about one-sixth between ten and twenty. The change in the arterial wall resembles that giving rise to aneurysm elsewhere—a fibroid degeneration, with loss of muscular and elastic tissue. Distensible tissue, which yields permanently before the blood-pressure, is substituted for the resilient elements of the wall, which, normally, bring back the vessel to its previous size after each diastole. The alteration is occasionally part of a widely-spread arterial change, but more frequently is local. It is then due to some local process, usually one of three kinds: (1) syphilitic disease, which has altered the wall, but has not obliterated or greatly reduced the lumen of the vessel; (2) injury—a blow or fall on the head, which probably acts by causing a local arteritis, whilst extensive traces of old inflammation are sometimes found in the neighbourhood of the aneurysm in such cases; (3) embolism, imperfect occlusion of the vessel by a plug, from a valve affected with active endocarditis. Dr. Church first pointed out the association in young persons of cerebral aneurysm with valvular disease of the heart; and so many facts have been published which support the opinion, that the relation must be regarded as beyond question. It is an occasional cause of aneurysm in other situations. There is often evidence of inflammatory and degenerative changes (thickening, calcification) in the arterial wall after embolic occlusion, especially when the plug comes from an inflamed endocardium. It then seems to have the power of exciting a considerable degree of inflammation in the tissue with which it is in contact, and the elements of the wall of the artery may be altered as by traumatic arteritis. If the obstruction is incomplete, the altered wall may yield to the blood-pressure. This cause explains the greater frequency of aneurysm in the left than in the right middle cerebral, and also the fact that those who suffer from cerebral hæmorrhage frequently have valvular disease of the heart, and in a still larger proportion in young persons. Whatever is the cause of the alteration in the arterial wall, the efficient agent in the production of the aneurysm is the high blood-pressure in the cerebral arteries, coupled perhaps with a slighter external support than is possessed by the vessels in other parts.

Rupture has occurred in more than half of the recorded cases of cerebral aneurysm. The blood may escape rapidly or slowly, and the hæmorrhage may take place into the subarachnoid space, or into the adjacent cerebral substance. In the former case, meningeal hæmorrhage is the result. Rupture into the cerebral substance is not uncommon. An aneurysm in the fissure of Sylvius may cause a hæmorrhage into the substance of the brain, bursting into the lateral ventricle; and an aneurysm on the posterior cerebral artery may burst into the substance of the pons. Two causes may determine this rupture into the substance of the brain — first, thickening of the subarachnoid tissue adjacent to the aneurysm, hindering its rupture outwards; secondly, the small size of the opening and consequent gradual escape of the blood, producing a slow disintegration of the brain-tissue, and thus preparing a channel for the effusion. In such cases only a small quantity of blood may have trickled into the ventricles or subarachnoid space. In rare cases a communication with a venous sinus forms, and constitutes an arterio-venous aneurysm. This has occurred between an aneurysm of the internal carotid and the cavernous sinus.

Symptoms.—Symptoms of the existence of an aneurysm may be entirely absent. When present, they depend on the pressure which the tumour exerts on neighbouring parts. They vary widely according to its seat, and they are rarely by themselves distinctive. Mental disturbance is uncommon. Headache is a very uniform symptom. It is often intense, sometimes throbbing, and may be localised, as in the occiput in basilar aneurysm. Giddiness is not uncommon, and is complained of in aneurysms in all situations. Convulsions are not frequent except in cases in which the aneurysm is in the neighbourhood of the motor region of the cortex, *i.e.* is on the middle cerebral or its branches. Palsy in some situation often occurs, and depends on the pressure of the tumour; the most common is that of the cranial nerves which lie adjacent to the aneurysm, as of the nerves of the orbit in aneurysm of the internal carotid. Optic neuritis is occasionally present. The symptoms are thus those of an intracranial tumour, and they suggest an aneurysm when they are such as to show that the tumour is in the position of one of the arteries liable to be affected; and the probability is increased if one of the known causes of aneurysm can be traced. Aneurysms elsewhere would, of course, give great additional significance to the symptoms, but the coincidence is too rare, an instance being almost unique, to be of practical importance. In some cases a murmur can be heard by the patient, and in still rarer cases (of aneurysm of the internal carotid) it has been audible on auscultation. But such an objective murmur alone can not afford actual proof of the existence of an aneurysm, since pulsation, the chief sign of an accessible aneurysm, can never be perceived.

Rupture of an intracranial aneurysm gives rise to symptoms which vary according as the blood escapes quickly or slowly. If quickly, the blood usually escapes into the meninges and causes sudden apoplexy with general paralysis, rapidly deepening to a fatal issue. If slowly, the symptoms are less sudden, and unilateral paralysis or convulsion may occur. This is especially the case when the blood escapes slowly into the cerebral substance; the unilateral symptoms commence suddenly, and gradually increase during a few hours or days, with or without initial loss of consciousness, but ending in fatal coma.

Treatment.—Little can be done in cases where intracranial aneurysm is suspected. Even when it is of syphilitic origin, drugs are powerless to alter the damaged and dilated vessel, since the change which has given rise to it is of the nature of a cicatricial transformation of the syphilitic tissue, on which drugs can no longer exert the influence they possess over the earlier stages of the newly-formed growth. Hypodermic injection of ergotin ($\frac{1}{6}$-grain) has been recommended by Langenbeck and advocated by Bartholow. Iodide of potassium may also be given in the hope of promoting coagulation within the sac, from the undoubted evidence of the power it has to effect this in aneurysms elsewhere. Rest is important. All causes of increased intravascular pressure, such as effort and low positions of the head, are to be avoided. The bowels should be kept regular. In rare cases where progressive paralysis of orbital nerves suggests the probability of aneurysm of the internal carotid, and a murmur renders the diagnosis certain, ligature of the common carotid may be, and has been, resorted to with success. It is, moreover, probable that intracranial surgery may be able to cope with aneurysms on some other vessels, but on this point experience has still to be gained.

(*b*) *Minute 'miliary' aneurysms* occur in the small arteries of the pia mater and substance of the brain (Virchow, Charcot, and Bouchard). They are met with almost exclusively in the second half of life, and increase in frequency with age up to about seventy-five, the less frequency of cerebral hæmorrhage in extreme old age making it probable that they are less common in very late life. They may involve vessels not more than the $\frac{1}{100}$ inch in diameter, but are most common on vessels a little larger than this. The walls suffer fibroid degeneration of the outer and middle coat, commencing, it is said, as nuclear proliferation. The muscular tissue of the middle coat disappears, and the whole wall at the spot becomes dilated into a sacculated aneurysm, varying in size from the $\frac{1}{25}$ to the $\frac{1}{125}$ of an inch. These dilatations have been found in all parts, but most frequently in the central ganglia, and next most frequently in the pons Varolii, the convolutions, the cerebellum, the medulla oblongata, the cerebellar peduncles, and the centrum ovale (Bouchard). They are to be found in most cases of cerebral hæmorrhage; and it is probable that such hæmorrhage is usually due to their rupture. Similar minute aneurysms of the retinal arteries co-exist in rare cases.

Tho rupture of a minute artery into its perivascular sheath distends this with blood, causing what has been termed a minute dissecting aneurysm. Such are frequently met with in cases in which tho vessels are exposed to extreme pressure, as in death from asphyxial conditions; or in the increased tension in collateral vessels when vascular obstruction has occurred.

Symptoms.—No symptoms are known to be associated with the existence of these minute aneurysms, and this fact explains the absence of indications of a liability to cerebral hæmorrhage. The symptoms of rupture are described under Brain, Hæmorrhage into.

2. **Degeneration.**—(*a*) *Of Arteries.*—The larger cerebral arteries are very common seats of the thickening of the inner coat, called by Virchow 'endarteritis deformans,' and which, when fattily degenerated, constitutes 'atheroma.' In the cerebral vessels the fatty change occurs quickly and frequently; and opaque yellow thickenings are the result. Only one or two of these may be present; or the change may involve the whole of the larger vessels at the base and extend for a considerable distance along the chief cerebral branches. The distribution of the degeneration may be symmetrical. It may coexist with a similar change in arteries elsewhere, or may be isolated. Degeneration of the cerebral arteries is common after middle life, being found in seven-tenths of the subjects examined (Bichat). It occasionally occurs much earlier, especially in cases of chronic Bright's disease and alcoholism. The exciting cause of this disease is probably the strain to which the badly supported cerebral vessels are exposed in consequence of their early origin from large trunks, perhaps rondered more effective by the deficient support from adjacent structures. The influence of strain explains the relation of atheroma to Bright's disease, in which the arterial tension is so much increased. It is not easy to explain the occasional freedom of these vessels from atheroma when this is abundant elsewhere.

The degenerated tissue occasionally softens and a cavity forms and opens into the vessel, so as to permit the formation of a dissecting aneurysm. More commonly it undergoes calcification. The result of these thickenings of the wall is generally to lessen the calibre of the vessel, sometimes to close it altogether, to cause local anæmia of the brain, and to favour the formation of a coagulum in the unnarrowed part beyond, with the result that softening occurs in the part supplied by it. Where the change in the wall is slight, the new tissue may undergo fibroid change only, the wall remains thin, the artery may be dilated at the spot, but the tissue formed in this process is seldom extensible enough to permit a true aneurysm to result. Hence it is rare for arteries affected with atheroma to give way, and permit hæmorrhage to take place; the change in the wall differs from that which permits the extension (into an aneurysm) which precedes rupture. The minute arteries of the cerebral substance may undergo fatty degeneration, but they do not suffer from the change above described. There is not, in them, the formation of a new tissue that undergoes fatty degeneration, although their elastic elements may be replaced by the inelastic extensible tissue that permits the formation of an aneurysm.

Symptoms.—Atheroma of the cerebral vessels leads to the symptoms of local anæmia of the brain, and is a common cause of tho transient cerebral symptoms so frequent in the old. Tingling in the limbs of one side, and slight loss of power, may be due to this cause, and are frequently the precursors of an attack of hemiplegia from the closure of the vessel. It is possible also that the loss of memory and mental failure common in the old may be the result of more general interference with the supply of blood to the brain in consequence of this arterial disease, or of the deficient supply to certain parts subserving more general psychical functions. But caution should be observed in ascribing such senile symptoms to this mechanism; general symptoms are probably more frequently due to senile failure in the nutrition of the cells of the cortex.

Treatment.—Tonics, cardiac stimulants, and substances which, as cod-liver oil, promote the nutrition of the tissues generally, may be given with possible advantage. It is not likely, however, that any treatment can modify the state of the arterial wall, or that its tissue ever resumes, in any degree, its normal characters. The maintenance of the general nutrition in a good state may lessen the tendency to fatty degeneration and subsequent calcification of the tissue, and thus postpone or prevent the disastrous consequences of occlusion of the vessels. In this, however, we can only adjust our treatment on rational grounds, since the nature of the case precludes any possible evidence of beneficial result. Of especial importance is it, in any case in which there is reason to believe or to suspect the presence or future development of atheroma, to do all in our power to keep the arterial tension within normal limits, and to preserve the blood from the presence of the products of imperfect digestion and the accumulation of metabolic products, which favour thrombosis.

(*b*) *Of Veins.*—Degeneration of the walls of the veins is much less frequent than degeneration of the arteries, perhaps on account of the less degree of pressure to which they are exposed. Disease of them is generally the result of inflammation communicated from without. Occasionally the veins of the pia mater may be found varicose in advanced life, and in one case recorded by Andral rupture of such a dilated vein was the cause of meningeal hæmorrhage.

3. **Embolism.**—Definition.—The obstruction of arteries or capillaries of the brain by solid particles carried by the blood-current from some other part of the vascular system.

Ætiology.—The source of the embolic particles is almost invariably situated between the pulmonary capillaries and the obstructed vessels, *i.e.* in the pulmonary veins, the left side of the heart, or the arteries. In arterial embolism it is necessarily so, since no particles large enough to obstruct even a small artery could pass through the capillaries of the lungs. In almost all cases the heart is the source of the plugs, a particle of fibrin being washed by the blood from a deposit on a diseased valve or in some recess (as the auricular appendix). Endocarditis, or chronic valvular disease, therefore, usually coexists with the embolism. Mitral stenosis is an especially frequent source of emboli, probably because the surface is commonly much altered, and the blood-current is in part slow (in diastole, allowing deposit), and in part very rapid (in auricular systole, detaching loose fibrin). Moreover the dilatation of the left auricle, and the imperfect degree in which the blood is expelled from it, frequently lead to a coagulum in the appendix. Disease of the aorta—atheroma or aneurysm—is the next most frequent source, and, less frequently, disease of the carotid or vertebral arteries, and coagulation in the pulmonary veins, large or small—the latter in some rare cases of inflammation and growths.

Particles obstructing capillaries may come from some softened atheromatous patch or fibrinous deposit, from pigmentary formations, or from deposits in ulcerative endocarditis. In the last case the obstructing material has a septic character, probably due to bacterial organisms, and the inflammation it causes may be suppurative.

Embolism occurs with equal frequency in both sexes, and at all periods of life, but most frequently between later childhood and middle life. This is explained by the fact that it occurs more readily from valvular disease due to endocarditis, than from that which results from the degeneration of age, but most frequently when the lapse of time has led to secondary changes in the valves damaged, or during second attacks of endocarditis—inflammation of valves previously diseased being especially prone to give rise to embolism. Hence most subjects of embolism have suffered or are suffering, from one of the diseases known to cause endocarditis, and especially from rheumatic fever.

Anatomical Characters.—Almost any of the cerebral arteries may be obstructed; but the vessels most prone to suffer are the middle cerebrals, in consequence of the more direct circulation into them. Next in frequency are the internal carotid and the anterior cerebral. Embolism is less frequent in the arteries to which the vertebrals convey blood, but has been met with in most of them; even the basilar may be obstructed by a clot small enough to pass through the vertebrals, but too large to enter the posterior cerebral. The cerebellar arteries are those least frequently affected. Obstruction of several vessels is sometimes found, having occurred at the same or different times. Embolism is more common on the left side, but the difference is not so great as is often stated, being not greater than as four to three. It is due to the more direct origin of the left carotid, into which a plug can therefore be more easily carried than into the right; hence it depends on the greater frequency of the occlusion of the branches of the internal carotid, and especially (because it is the vessel most often affected) of the middle cerebral. The left vertebral is also rather more often plugged than is the right, but embolism of this artery is too rare materially to influence the numerical relation between the vessels of the two sides in their liability to accident.

The plug is usually arrested at some spot at which the vessel is narrowed by a branch being given off. Here the fragment may be found, usually decolourised, and commonly closing altogether the lumen of the vessel. On each side of this is a secondary clot: the distal extends far into the contracted branches of the vessel, the proximal as far as the next large branch. The obstruction may lead to inflammation of the wall of the vessel at the spot, especially when the plug has been carried from a place at which inflammation is going on. The inflammation leads to change of texture and degeneration, fibroid or fatty; the former may permit an aneurysm to be formed, the latter may cause a thickened patch, in which calcification may occur. The inflammation may spread to the adjacent tissue, leading to induration around the spot. It is most intense when the plug comes from a valve the seat of active endocarditis, and may then determine a peculiar irritative character in the secondary inflammation, as is shown by the fact that optic neuritis sometimes develops in such cases.

The effect of embolism is to arrest the blood-supply to the part to which the artery is distributed, unless the blood can reach it by some other channel; the cerebral tissue, deprived of its circulation, undergoes necrosis and the necrotic softening described in another article. This result, however, is often prevented by the anastomoses that exist, and as these are very irregular in the cortex of the brain, both in different persons and in different parts of the same arterial area, considerable variations exist in the extent of softening that results from occlusion of the same artery. But in the central ganglia anastomoses are absent, and softening uniformly follows. Thus embolism of the middle cerebral may cause softening of the corpus striatum, and the cortex supplied may be intact, softened in irregular areas, or totally destroyed. Capillary embolism also causes softening, and when the obstruction is from a septic source, 'metastatic abscess' may result. Thus cerebral abscess results from suppurative disease in the thorax and other parts. One of the rare curiosities of pathology is the production of such abscess by the embolic obstruction of the vessels with fragments of *oidium albicans.* A plug of fibrin sometimes quickly breaks up, and is carried into the capillaries, so that the artery is pervious, although the brain-tissue it supplies is necrosed. Necessarily, when the capillaries are obstructed, a collateral blood-supply is of no avail to prevent softening.

For the SYMPTOMS, DIAGNOSIS, and TREATMENT of cerebral embolism *see* BRAIN, Softening of.

4. **Rupture.** — Rupture of cerebral arteries is common and is the cause of cerebral hæmorrhage; and rupture of capillaries is not infrequent. Rupture of veins is extremely rare, except as the result of injury.

(*a*) *Of Arteries.*—The proximate causes of rupture are weakening of the arterial wall, and increased pressure within the vessel. The conditions which give rise to these two factors are the remote causes of rupture. The actual rupture is commonly due to a temporary sudden excess of intravascular pressure.

ÆTIOLOGY.—The wall of the vessel is weakened, especially by degenerative disease —chronic periarteritis, or (rarely) simple fatty degeneration. Aneurysmal dilatation and thinning may have resulted from the chronic change. In some diseases attended with a tendency to extravasation (purpura, hæmophilia, &c.) it is probable that the vascular walls undergo rapid degeneration (in the acquired), or are unusually thin (in the congenital) maladies. Defective external support, from atrophy of the brain, causing increased size of the perivascular canals, was formerly thought to be a potent cause, and is now perhaps underrated. The mobile perivascular fluid which surrounds the vessels must afford a less efficient support than cerebral tissue, and sudden variations in the size of these canals will expose the vessels to sudden differences in the amount of tension to which their walls are exposed.

When vessels are much weakened, they may rupture when the extravascular pressure is at, or even below, the normal; very commonly, however, there coexists increased pressure. Loss of arterial elasticity leads to a jerky pressure. Arterial degeneration, and still more constantly, arterial contraction, in Bright's disease, cause increased tension by obstruction; and the hypertrophy of the heart, which develops to overcome the obstruction, adds materially to the pressure within the arteries. Hypertrophy to overcome an obstacle near the heart has probably no influence in causing rupture of cerebral vessels.

The immediate cause of rupture is generally some temporary increase of the blood-pressure due to effort—as in cough, straining at stool or vomiting; excited action of the heart; suddenly developed heart- or lung-disease obstructing the circulation; local obstruction to return of blood; contraction of the arterioles, general or local; or the action of gravitation in the recumbent posture. The last two causes, acting together, probably determine the frequent occurrence of rupture during sleep.

The conditions which produce these proximate causes are the remote causes of rupture. The most efficient are those which determine weakening of the vascular wall, and have already been spoken of (*see* Degeneration). Age is an important element—rupture is most common after fifty, but may occur from local vascular disease at any age. Hereditary predisposition is effective by a tendency to early degeneration, and is often very conspicuous; several members of the same family die at the same time of life from this cause. Position of degeneration is probably largely influenced by the distribution of the vessels; and the latter may be hereditary, as the retina sometimes strikingly shows us: the same distribution of the retinal artery may be seen in parent and child. So, too, correspondence in the way in which the cerebral arteries of the two sides divide and are distributed may be observed to coincide with a close correspondence in the position of spots of visible degeneration, and doubtless also determines a like symmetry in the *invisible* degeneration of these aneurysms; hence rupture sometimes occurs at the same place in each hemisphere. Sex tells probably by exposure to the greater pressure entailed by muscular effort (men suffer from rupture twice as frequently as women). Alcoholism leads to early degeneration. But the most efficient predisponent is Bright's disease, which leads to great intravascular pressure, and weakens the cerebral vessels by causing degeneration. It is probable that some acute diathetic diseases in which rupture is common act in a similar manner.

Some of the cerebral arteries give way more frequently than others, especially the arteries of the corpora striata and pons Varolii. This seems due (1) to their origin at right angles from vessels of very considerable size (basilar and middle cerebral), and their consequent exposure to the full pressure within the parent trunk. (2) To their 'terminal' character, which precludes collateral relief when a general increase of intra-arterial pressure augments disproportionately that in an artery in which it is normally above the average for the size of the vessel. One artery, which very frequently gives way, passes from the middle cerebral through the anterior perforated spot, outwards between the island of Reil and the lenticular nucleus, the outer part of which it perforates, and then passes through the white 'internal capsule,' between the lenticular and caudate nuclei, to ramify in the anterior part of the latter. The arterioles supplying the convolutions on the surface of the brain are not often ruptured, except from injury. They are exposed much less directly to the blood-pressure, and sometimes possess considerable anastomoses.

Symptoms.—The consequence of rupture of an artery is cerebral hæmorrhage, the symptoms and treatment of which are described elsewhere (*see* Brain, Hæmorrhage into). In traumatic laceration of the brain the arteries are torn, and often cause much hæmorrhage.

(*b*) *Of Capillaries.*—The minutest arteries, and veins, and the capillaries rarely rupture, except when exposed to sudden pressure by venous thrombosis, when the obstruction in the part from which the vein proceeds may determine numerous capillary hæmorrhages into the cerebral substance. In general venous congestion, as in asphyxial states, such hæmorrhage may occur; but a more frequent result is rupture of a vessel within its perivascular sheath, which thus becomes distended with blood.

For symptoms *see* Brain, Hæmorrhage into.

5. Syphilitic Disease.—The arteries of the brain are occasionally diseased in constitutional syphilis, between the first and twelfth year after infection, but occasionally in the earlier or later stages of syphilis. The large arteries at the base are those commonly affected; very rarely a similar change invades the minute arteries of the central substance. Usually more than one vessel is affected. It is generally the result of the acquired, but sometimes of the congenital malady. The frequency of the lesion is not known, since it is only recognised when the affected artery becomes occluded or greatly narrowed by the change. The disease may occur without this consequence and probably does so not rarely, and is removed by treatment adopted on account of simultaneous manifestations in other situations. The wall is thickened at circumscribed areas by a fibro-nuclear growth, which causes a nodular projection on the exterior, and diminishes also the calibre of the vessel. The structure of the growth resembles that of syphilomata elsewhere. It begins by a nuclear proliferation between the inner coat and the elastic lamina, and it attains its chief development in this situation, the elastic lamina being pushed outwards and the lumen of the vessel obliterated. The middle coat may ultimately disappear. Vessels may form in the substance of the growth, and may subsequently be obliterated, leading to the irregular fatty degeneration so characteristic of these formations. The disease is sometimes symmetrical on the arteries of the two sides. The growth or secondary thrombosis occluding the vessel, softening may result in the area of brain-tissue supplied by it. Since the symptoms due to the occlusion are usually sudden, it is probable that the final arrest of the diminished blood-supply is always through the agency of thrombosis. As in other forms of arterial narrowing, when a certain degree of constriction is reached, the condition of the circulation in the vessel beyond must of necessity be such that clot forms on the altered wall, and at last the blood-flow suddenly ceases. The softening resembles in its occurrence and characters that which is produced by degenerative changes in the arteries, but is more varied in its seat, and it affects younger persons. The diminished elasticity of the diseased wall, when the thickening is slight, may permit the dilatation of the vessel into an aneurysm. Possibly the same result may follow the fatty degeneration of the new tissue.

Symptoms.—No symptoms are produced by the arterial disease until it causes local anæmia or softening, the symptoms of which resemble those due to other causes.

Treatment.—This is that of the later stages of syphilis. It must be remembered that the removal of arterial disease may not restore the damaged cerebral tissue.

6. Thrombosis.—Thrombosis—the coagulation of the blood *in situ*—may occur in the cerebral arteries; or in the cerebral veins and sinuses.

(*a*) *In the Arteries.*

Ætiology.—The causes of arterial thrombosis are the following:—

(1) An alteration in the wall of the artery, by which the blood comes in contact with an abnormal surface. The most common condition is atheroma, and hence arterial thrombosis is most frequent when atheroma is most common—in the old. Syphilitic disease of the artery sometimes leads to it. Much more rarely it is caused by an arteritis, spontaneous, or the result of adjacent inflammation or traumatic damage.

(2) Retardation of the blood-current. This may result from weakened action of the heart in debilitating diseases (as phthisis and cancer), and in extreme fatigue. It may be part of the effect of a convulsive fit; or it

may be caused locally by the arterial diseases mentioned already, which lead to narrowing and loss of elasticity.

(3) An increased tendency of the blood to coagulate. This is seen in many diseases, especially in marasmic states in young and old (such as are caused by phthisis and cancer), in acute rheumatism, and in the puerperal condition. A slight cause then suffices to produce coagulation, and the weak heart, so common in many of these conditions, may cause sufficient retardation of the blood-current.

(4) Lastly, thrombosis in an artery may be *secondary* to its complete or partial obstruction by an embolus.

ANATOMICAL CHARACTERS.—The arteries occluded may be one or several, and large or small. Thrombosis occurs most frequently in the internal carotid, middle cerebral, vertebral, and basilar arteries, or their branches. It is not uncommon for a clot to form in a branch that comes off at a diseased spot, while the main artery continues pervious. The orifice of the branch is narrowed so that enough blood does not enter to maintain the circulation in the part beyond. The vascular wall may present any of the local causal conditions already mentioned, or it may be healthy. After a time thickening from secondary arteritis occurs. Within the vessel is a coagulum which usually fills its interior, and is adherent to the wall. It may not fill the vessel, either because originally imperfect, or because the clot has shrunk. A recent quickly-formed coagulum is red, but after a time it becomes pale and yellow. A slowly-formed coagulum is pale, and may be laminated. A secondary clot usually forms far into the contracted distal branches, and on the proximal side as far as the nearest large branch. Ultimately the clot may, rarely, soften, the channel being sometimes re-established. More commonly it undergoes calcification, or, with the artery, contracts and becomes atrophied. The brain-tissue, in which the artery was distributed, may be at first anæmic, but quickly becomes congested. It ultimately undergoes softening—red, yellow, or white, according to the amount of vascular distension. If the collateral circulation is free, it may remain unsoftened.

SYMPTOMS.—Where chronic arterial disease is the cause of thrombosis, it may be preceded by the symptoms of local cerebral anæmia (*see* BRAIN, Anæmia of). The thrombosis itself leads to the symptoms of loss of function in the part to which the artery passed. The onset of these symptoms is slow or sudden, according to the rapidity with which the coagulum forms; and their degree depends on the size of the vessel occluded, its position, and its relation to other vessels which may supply blood to the area involved. Thrombosis of a small vessel in the cerebral substance usually leads to transient brain-disturbance, headache, vertigo, tingling, and temporary weakness in the limbs, which soon pass away if a collateral circulation is established; more slowly, if softening ensues, by compensatory action elsewhere. The occlusion of a large vessel causes commonly more marked symptoms. Complete hemiplegia is frequent, and its onset may be marked by loss of consciousness. *See* BRAIN, Softening of.

DIAGNOSIS.—The diagnosis rests on a combination of the symptoms of local cerebral disease with the causal condition—vascular mischief (indicated by probable age, degeneration elsewhere, or syphilis), and with conditions leading to relaxation of the blood-current, or increased coagulability of the blood. The diagnosis is rendered more probable by the symptoms if slight being transient, if severe being of gradual onset, and, whether slight or severe, being preceded by the premonitory indications of local cerebral anæmia.

The PROGNOSIS and TREATMENT of thrombosis in arteries are considered under its consequence, BRAIN, Softening of.

(*b*) *In Cerebral Veins and Sinuses.*

ÆTIOLOGY.—Thrombosis in sinuses may be primary, and due to changes in the constitution or the circulation of the blood; or secondary, and due to local causes inducing coagulation directly at the spot affected. Secondary thrombosis is the more common. The same conditions of retarded circulation and altered blood-state which permit coagulation in arteries, favour it also in veins, and it is often seen in such conditions as phthisis and cancer, and especially in marasmic states in children. Hence the primary form is most common in children, but the secondary form occurs with nearly equal frequency through life. Local retardation of the circulation from narrowing of the sinus, or compression of the jugular vein, occasionally assists. The blood-current in the front part of the longitudinal sinus is one of extreme sluggishness, on account of the physical conditions of the circulation. Local change causing coagulation is usually the extension to the sinus of adjacent inflammation, or of a clot produced in a tributary vein by such inflammation. Caries of the bones of the skull, especially of the temporal bone, and meningitis are common causes. Lastly, injuries of the skull involving the sinuses sometimes cause coagulation in them.

ANATOMICAL CHARACTERS.—Of primary thrombosis the superior longitudinal sinus is the most common seat, and thence the clot spreads into the veins on either side, and often also into the lateral sinuses. When secondary, the thrombosis occurs in the sinus nearest to the local mischief; in disease of the petrous bone, the lateral sinus is usually involved. The sinus is distended by firm clot, commonly (not invariably) adherent, sometimes in concentric layers. The walls of the vessel are healthy when the thrombosis is primary or secondary by extension of clot, but thickened and brittle when invaded directly by adjacent inflammation. After a time the clot may soften and break down.

The consequence of venous thrombosis is local arrest of the blood-current, the tributary veins and capillaries becoming enormously distended with blood and rupturing, and the cerebral substance being crammed with minute capillary extravasations which often coalesce. The condition is frequently seen in the convolutions. Blood is also effused into the meshes of the pia mater, and into the subarachnoid space. Into the looser tissues and into the ventricles serum may escape. Thrombosis of the veins of Galen is one cause of ventricular effusion. Ultimately the brain-tissue, the seat of the ischæmic congestion, undergoes softening, first red, and then yellow or white. Occasionally the softening of the clot leads to pyæmia.

Symptoms.—The symptoms vary in their character. Sometimes they are at first those of mental excitement, namely, intense headache and muscular spasm, shown as contractions in the limbs, or as convulsion, often beginning locally, according to the position of the congestion. These symptoms, after one or several days, are succeeded by those of depression; with coma, and dilatation of pupils. In other cases the coma may come on suddenly, and the stage of excitement, above described, may be absent or little marked. Now and then hemiplegia slowly comes on, without initial loss of consciousness, and develops to a complete degree in the course of a few hours or a few days. Convulsions, when they occur, often continue till death. When the superior longitudinal sinus is plugged, epistaxis, œdema of the forehead, and exophthalmos have sometimes been observed. When the lateral sinus is obstructed, there may be painful œdema behind the ear, and the jugular vein on that side has been noticed to be less full than on the other.

Diagnosis.—The diagnosis rests on the occurrence of severe cerebral symptoms in association with a causal condition, constitutional or local.

Prognosis.—This is always serious, death being, in most cases, speedy.

Treatment.—The indications for treatment are mostly causal. In primary thrombosis stimulants and nutritious diet are necessary, and tonics if they can be taken. The patient should lie with the head and shoulders a little elevated, and care be taken that the neck is not bent, and that there is no constriction of it by tight clothes. In secondary thrombosis, occurring in robust individuals, leeching or cupping is recommended; purgatives should be given; and in the less severe cases a blister may be applied to the neck, and the utmost care taken to afford free exit for pent-up inflammatory products. Pain and convulsion are relieved most effectually by cold to the head.

W. R. Gowers.

BRAIN FEVER.—A name popularly applied to any kind of febrile state in which symptoms of cerebral excitement are prominent; as well as to cases of inflammatory disease of the brain or its membranes.

BREAK-BONE FEVER.—A synonym for dengue. *See* Dengue.

BREAST, Diseases of.—Synon.: Fr. *Maladies de la Mamelle*; Ger. *Brustdrüsenkrankheiten.* This subject will be treated under the following divisions:—

I. *Diseases before puberty*, in both sexes. II. *Diseases about the age of the establishment of puberty; and after that period*, in the female.—(A) in the *active* state of the gland; (B) in the *passive* state. III. *Diseases* affecting the rudimentary organ *in the male.* IV. *Diseases of the nipple.*

The diseases of an organ composed essentially of glandular structures have here to be described. The mammary gland is classed with those termed racemose; but it differs from every other organ in the body of a similar class, inasmuch as it only arrives at maturity when its function is to be subservient to the nourishment of the offspring. In its perfection it appears, normally, only in the female sex, and even then it does not become developed until the internal organs of generation are capable of performing their functions.

Hence, to describe systematically the diseases of the breast, it is requisite to treat of them not only in reference to sex, but also in relation to the different periods of life at which certain diseases appear. Briefly then, from a histological point of view, they occur: (*a*) in the rudimentary state of the gland; (*b*) in its mature state; (*c*) when it has become a secreting organ; (*d*) during a state of degeneration.

I. In the *rudimentary period* of the gland the tissues composing it are rarely liable to morbid derangement. Usually, soon after birth, especially in male infants, the rudimentary nipple and the skin of the region within the zone of the areola become slightly elevated and of a pink hue. In some infants a secretion, slightly milk-like, oozes from the ducts. In this state, the injudicious rubbing practised by the attendant excites inflammation, which, if not arrested by desistance from that pernicious interference, may advance to suppuration. When that happens, the abscess must be incised and treated on ordinary principles.

II. *About that age, in both sexes,* when the development of the generative organs advances with greater rapidity to maturity than in early life, the breast-gland enlarges, and may be painful, thus causing anxiety to the individual. Development usually takes place symmetrically in the female; but, when the gland of the one side takes precedence of that of the other, the circumstance need only be regarded as a departure from the ordinary rule, for no trouble will result, and in due time both will attain their normal proportions. In the male, pain or uneasiness sometimes occurs for a few days about this period, very often excited by the pressure of the dress. The removal of this cause is sufficient to arrest further mischief.

In the female the development of the breast having reached maturity, the gland becomes associated by sympathetic influences communicated through nervous stimuli with the functions of the pelvic generative organs. This physiological fact should always be remembered when investigating the nature of the morbid affections of this organ.

From a clinical point of view, it is essential to examine the diseases of the breast under the two states before mentioned, namely—(A) whilst the gland is undergoing metamorphosis into a secreting organ, and during lactation; (B) as a mature gland, but passive as regards its function.

Glancing at the various morbid states of the body of the gland as a whole, they may be divided, primarily, into two groups:—the *functional* derangements; and the *structural* or histological diseases.

We will now proceed to discuss these affections, as they are presented at the different periods mentioned above.

A. After conception the breasts soon begin to enlarge, and minute pisiform indurations may be felt at their borders and surface. Occasionally, but very rarely, this normal increase in bulk is attended with considerable pain and irritation extending throughout the nervous relations of the gland. The pain is referred to the back, neck, inside of arms, shoulders, and side of thorax—over, in fact, the area of distribution of the branches of those intercostal nerves which send filaments to the breasts. It affords a good example of reflected irritation. This state usually occurs after the first conception, and in women of excitable, nervous temperament. Attention to ordinary hygienic measures during the progress of the metamorphosis of the organ into a secreting gland, with its accomplishment, affords relief to the pain. In large, lax, pendulous breasts, the separate lobes of which each is composed may excite apprehension of the existence of a tumour. But tumours composed of new tissue are so extremely rarely developed during pregnancy, that the greatest caution must be exercised in the diagnosis of their nature.

Agalactia.—Very rarely, no change whatever in the breasts accompanies pregnancy, under which circumstances there is an absence of the secretion of milk after parturition.

Inflammation of the Breast.—Synon.: Mastitis.

Ætiology.—Before lactation, acute inflammation of the breasts is very uncommon. After lactation, on the contrary, it is very frequent. This morbid state is often the result of carelessness or ignorance on the part of the nurse. The slightest unusual fulness or 'knottiness' discovered after the infant has been sucking, and when the ducts and their terminal secreting vesicles should be empty, requires immediate attention. Congestion of a lobule or lobe with milk produces the nodule, and the cause of the impediment to its escape should be sought for. The state of the nipple is generally the origin of the difficulty. Either the orifice of a duct may be obstructed by epithelium, or a superficial ulceration exists around it. The morbid or defective states of the nipple are the most fruitful causes of inflammation and its results in the breast. Prophylactic measures should always be instituted when there is reason to fear that a defective development of the nipple will interfere with the free flow of the milk. Even with some mothers it would be advisable to resign the duty of suckling, rather than subject themselves to the almost certain misery arising from persistent and ineffectual attempts to do so. Inflammation, generally passing on to suppuration and abscess, either within the body of the breast or on its surface, is most frequent in primiparæ, and within the first month after parturition.

Symptoms.—First, hardness is felt, 'a knot,' in some part of the substance of the organ; this enlarges, and may attain to considerable dimensions before causing pain or even uneasiness. Next, pain is felt during suckling; this increases each time the infant sucks, and 'the draught' is produced. The integuments then become pink, and afterwards red, tense, shining; more or less of the breast feeling very inelastic, firm, prominent, and heavy. Pain is now often very severe, and great constitutional disturbance is excited. In the centre of the redness the skin becomes of a purplish tint; around this it is œdematous; and with the finger, at the centre of the purple zone, a slight depression and softening spot can be detected. An abscess now exists, and fluctuation is more or less marked in proportion to the quantity of pus. At the purple centre the cuticle has probably by this time separated from the cutis; and a vesicle containing serum, either yellow or slightly tinged with blood, indicates that ulceration of the cutis is proceeding, and that the pus will soon escape. The above is a brief description of the objective signs indicating the morbid processes noticeable in all cases of local inflammation advancing to and terminating in suppuration and abscess. It is not possible to state with any degree of exactness the period of time required for the accomplishment of these definite changes. It varies according to so many local and constitutional circumstances, that it would be idle to attempt to predict any certain definite period or stage for each phase. It will be more useful to describe the treatment by which the progress of the disease may be arrested or limited, and its painful course mitigated.

Treatment.—Great attention should always be given to the nipple of primiparæ. In many women, this important division of the gland is very small and undeveloped, perhaps only on one side, so that the infant, especially if not very strong, has great difficulty in obtaining sufficient milk to appease the appetite, and its efforts cause pain in the part. This circumstance induces the mother to prefer suckling most with that breast the nipple of which is perfect, and the infant soon appreciates the advantage of that side. Consequently the gland-tissue of that breast having the imperfect nipple becomes congested. Every time the infant sucks it becomes worse, more and more pain and irritation are excited, the orifices of one or more of the ducts in the nipple become blocked, and perhaps the infant refuses to suck the breast. But the gland becomes more and more distended, the nipple deeply buried, until at last suckling is impracticable. Probably none of these increasing troubles have been stated to the attendant surgeon; and, when he is consulted, he finds the breast to be in the state above described. The perfect development of the nipple should be always a subject of anxious solicitude on the part of the obstetric practitioner. If this organ be imperfect, precautions should be taken to prevent the gland itself from becoming congested, and if the infant cannot draw the milk sufficiently, some mechanical means should be employed to effect this object. The nipple itself should be examined. If its end be more than usually coated with secretion, or the openings of the ducts seem to be obstructed with an excess of epithelium, attempts may be made to remove it. If abrasions, ulcers, 'cracks or chaps,' are visible between the rugæ, a soothing application, or a weak solution of carbolic acid, should be used. Ablution with warm water, or the contact of a little moist cotton covered with gutta-percha tissue, is preferable to the dressing; or, if there be much secretion from the glands on the nipple, after cleansing its surface, some dry powder is beneficial, such as carbonate of magnesium, oxide of zinc, or starch powder.

When actual congestion of the gland-tissue exists, mechanical means should be used to reduce it. Supporting the gland with strips of plaster and a bandage is sometimes very useful. When inflammation is excited, local applications of warmth and moisture are indicated, and the constitutional condition of the sufferer demands special attention. The application of glycerine of belladonna and a suitable support of the breast are also of great service. When suppuration has taken place, its relation to the adjacent parts and the exact size of the abscess when formed should be carefully ascertained. There is great diversity in the progress, duration, and sufferings of the patient, depending upon the locality of the pus. It may be situated over the body of the gland, within it, or beneath it.

When *overlying* or superficial to the body of the breast, the course of the disease is rapid. In those cases the constitutional disturbance is usually trifling.

Both the local and constitutional symptoms are much more severe when inflammation affects *the body* of the gland, and pus collects between its lobes. The progress of the disease is tedious, pointing of the pus is slow, and the exact spot at which it may reach the surface is for a long time doubtful. In the majority of cases it makes its way between the ducts, and reaches the surface near the areola or within its area; usually to the sternal side of the nipple, where the gland-tissue is thinnest. In either case, as soon as the presence of pus is ascertained, it should be evacuated, by means of a short incision radiating from the nipple. This must be kept open by as large a drainage-tube as the incision will admit, and the strictest antiseptic treatment should be employed. The omission of the latter is very likely to lead to burrowing of pus and the development of troublesome sinuses.

When the abscess forms *beneath* the breast the local appearances are quite characteristic. The gland itself seems little involved, but it is pushed prominently forwards and seems to rest upon a cushion of fluid. To the touch the elasticity of the swelling is very striking, and, without producing additional pain, a slight bulging of the walls of the abscess may sometimes be produced at the periphery of the gland when, with the palm of the hand and outspread fingers, compression is made from the front backwards against the thorax. The patient should be recumbent. The pus in these cases often points somewhere around the borders of the body of the gland, and must be evacuated at the earliest possible date.

During the time occupied in the formation of a mammary abscess and its local treatment, the constitutional powers of the patient must be well supported, and the general health maintained by every means.

The *sequelæ* of suppuration in an organ composed of so much connective tissue, and endowed with its peculiar function, sometimes cause great trouble; they are, however, much less frequently met with now than before the introduction of the antiseptic treatment. They are protracted induration, sinuses, and fistulæ, through which last the milk persistently escapes. Induration of the whole or part of the breast subsides when lactation ceases, and the organ in due time resumes its healthy state. Sinuses and fistulæ may require incisions, but the ordinary methods for their cure should be adopted before having recourse to a treatment often involving much subsequent deformity.

At the time for weaning the infant inflammation rarely occurs. Considerable milk-congestion of the secreting structure may sometimes produce irritation and inconvenience, to be relieved by mechanically drawing the milk in just sufficient quantity only to diminish the fulness.

Galactocele.—An accumulation of milk, to which the above term is given, forms a tumour in the connective tissue of the organ, and results from the bursting of a lactiferous tube. The swelling always appears first during lactation. It may vary in size from time to time; sometimes enlarging rapidly as suckling goes on. Two varieties are met with. In the one form there is a single swelling near the nipple, quite superficial, and quickly recognisable by its objective signs. In the other there may be several swellings distinguishable in the substance of the gland, as well as on its surface, all of comparatively small size, very firm and globular. In the same gland they vary very much in size, and in the degree of resistance they offer to manipulation. The discrimination between these tumours and others in the breast is easy, if the surgeon is able to ascertain with exactness that the swelling appeared somewhat suddenly during suckling, and that its size varied conformably with that function.

In cases of long standing, the contents of the cyst become solid in proportion to the quantity of the fluid constituents of the milk absorbed, and the cyst-wall itself is very often rigid and even may become gritty.

Treatment.—The treatment of this malady consists in cutting into the cyst, removing its contents, and drainage.

B. The diseases affecting the mature gland, in its *passive* state, *from the age of puberty to that period of life when the catamenia cease*, may be grouped as follows:—the *functional* affections, or those which are characterised by changes in the secreting portion of the gland, accompanied by more or less induration, inconvenience, and pain; the *structural*, or those diseases characterised by some new-growth, which is altogether a superaddition to the organ, and—growing within its sphere of nutrition—often resembles, more or less, the gland-structure in composition; and others the minute elements of which are nucleated cells of various shapes, definitely and diversely arranged.

In this state of the breast *inflammation* rarely occurs. Nevertheless, both the acute and chronic varieties of that morbid process terminating in abscess are met with, and careful discrimination is necessary to avoid mistaking such diseases for new-growths, especially in patients above forty years old; for the amount of matter in a chronic abscess is often small, while the surrounding inflammation is often great and not infrequently an enlargement of the axillary glands, and some retraction of the nipple, make the diagnosis from cancer very difficult. The history of the case, tactile examination, and the variations occurring during the progress of the affection, commonly suffice for the detection of such cases. The treatment should be the same as for abscess in general.

Functional Derangements. — The functional derangements of the breast in its passive state demand special attention. They are characterised by a peculiar activity of its secreting portion, which undergoes structural changes of a specific kind. When the tissues composing a mature but perfectly passive gland are examined with the microscope, the cæcal terminations of the ducts are found to be small, and little else than fibre-tissue is seen. Here and there cæci may be detected containing minute aggregations of epithelium. But when, under some sympathetic excitement, with derangement of the functions of the pelvic generative organs, the secreting cells of the gland become active and are distended with epithelium, they induce more or less enlargement of the breast. This condition of things is called *chronic lobular mastitis*, and should perhaps more properly be included amongst the inflammatory diseases of the organ. But of such affections there is this important fact to be noticed. The whole breast need not be necessarily involved. On the contrary, one lobe only may be excited, and when this occurs the existence of a tumour is declared. When, after excision, such enlarged lobes are carefully examined with the microscope, normal gland-tissue is seen, the cæcal ends of the ducts are readily recognised, and their immediate association with the excretory ducts may be observed. The former are gorged with epithelium; and true gland-tissue, less its peculiar secretion, has been developed.

Symptoms.—Associated with this state of the tissues of the breast, the patient complains of pain, both locally and spread over a very wide area. To express as briefly as possible the superficial regions affected and over which pain is felt, the reader must be reminded of the distribution of the descending cutaneous branches of the cervical plexus, and of the lateral and anterior cutaneous branches of the second, third, fourth, and fifth intercostal nerves. From these, special filaments are distributed to the breast; and to the site of exit of one or more of them at the intercostal foramina, the source of the pain is referred by the patient. The skin of the neck, shoulder, side of thorax, and inside of arm receives filaments from the same source. Hence an explanation of the widely-diffused pain.

It is of the first importance to discriminate between this state of the gland-tissue and substantial new-growths, especially because the latter cannot be removed by natural processes, whilst the former most probably will be. The objective signs are the following: to the touch the excited gland-tissue is nodular, irregular over its surface, much identified and mingled with the body of the organ. If the whole breast be large and relaxed, the tips of the fingers may be insinuated between the borders of the indurated lobe and the lobes not affected. If the entire body of the gland be morbidly firm, it feels like a disc-shaped mass lying on the thorax, under the borders of which the fingers can be pressed. Occasionally, at one or more spots along the periphery of the gland irregular nodules are perceptible, projecting into the connective tissue around them. When one lobe is affected, the shape of the induration may be detected corresponding with that of a lobe, namely, broad at the periphery and gradually narrowing towards the areola. Pain as a subjective indication is of great assistance in forming a diagnosis of these cases; but the source and course of the pain must be carefully traced. Generally manipulation of the induration produces increased pain; occasionally touching the induration, even however gently, is intolerable, and persistence in or repetition of the act is strongly opposed by the sufferer. Light pressure should be made over the points of exit of both the anterior and lateral branches of the intercostal nerves, when the pain excited thereby will correspond with the nerve-filaments of the affected lobe. Pressure along the upper dorsal spinous processes usually excites pain also. The morbid affections above described occur in single women, married but sterile females, and young widows, at ages between twenty years and forty. More or less disturbance of the catamenia co-exists, either in relation to the frequency or quantity of the discharge. The patient complains of languor and inability for bodily or mental exertion; and she is desponding and often alarmed for the possible consequences of the affection suggested by sympathising friends. She is irritable, restless at night, loses appetite for food, as well as all desire for social enjoyments, and becomes highly susceptible and emotional.

Diagnosis.—An exact diagnosis of these histological changes may be made if the manipulator examines the organ methodically. He should, first, gently grasp the induration between the thumb and fingers, when it will be distinctly appreciable. Afterwards, placing the palmar surface of the fingers over the surface of the breast and gently pressing backwards against the thorax, the induration cannot be detected. Should there still remain any doubt on the subject, let the patient recline on her opposite side on a sofa, and in this posture, if there exists a substantial new-growth, the integument is usually elevated by it.

Treatment.—The treatment of these cases consists in attention to the general health. Every hygienic direction should be enjoined, and such medicines administered as conduce to its improvement. Local soothing applications are usually futile, and, except in those cases of extreme pain, are not advisable; but strapping with belladonna plaster may give relief, and will serve to support the breast and to prevent manipulation of the part, and the consequent frequent recurrence of the patient's thoughts to it. Should the gland be heavy and pendulous, a suspensory bandage, as thin as possible, may be adjusted.

New Formations.—We shall next describe the diseases of the mature gland arising from the development of new formations—either of tissues constituting new-growths; or of conditions causing collections of fluid of distinct and specific kinds. All of these may be thus arranged in three groups:—first, the *fluid* tumours; second, the *solid*; and, third, those composed of both *solid* and *fluid*.

A. **Cysts.**—The *fluid tumours*, commonly termed *cystic*, consist of a membranous sac with its contents. Now, calling to mind the histological divisions of the breast, and dwelling on the structural differences between its parts, the secreting apparatus and the excretory, there is little difficulty in assigning to the cysts their true histological affinities. Thus there are cysts associated with the secreting apparatus; others with the excretory, the ducts; and some due to the extravasation of the secretion of the gland, the milk, into the connective tissue. Effusions of blood also give rise to the development of cysts, either independently of other diseases or associated with them. Another variety of cyst is produced by the development of entozoa, notably of *echinococcus hominis*; and it must not be forgotten that cysts as well as abscesses may be developed in connexion with various kinds of tumours. An ordinary examination of the fluid derived from these cysts at once establishes the fact that heat and the admixture of nitric acid produce coagulation in that abstracted from some of them, whilst that from other cysts remains unaffected by the treatment. The cysts are thus divisible by the nature of their contents into two distinctly defined groups:—

a. Those containing fluid without the admixture of any coagulable element.

b. Those enclosing fluid which does contain coagulable material. Other characteristics of these two fluids are not less conspicuous.

From an objective point of view all cystic tumours of this gland may be classed in two groups, thus:—first, those associated with its ducts, the evidence of which is afforded by the escape of fluid at the nipple; and secondly, those not connected with the ducts by any such evidence.

The following tabular arrangement will place before the reader, at a glance, all the varieties of cysts met with in the breast.

I. *Cysts associated with the ducts,* communicating and connected with them.
  1. Containing milk.
  2. Enclosing growths; with serum, coagulable and often tinged with blood:—
    a. Adenoid growths.
    b. Granulation cell-growths.
    c. Cancer.

II. *Cysts not connected with the ducts.*
  1. Surrounding effused blood.
  2. Enclosing milk.
  3. Simple cysts. } Fluid not coagulable.
  4. Entozoon cysts. }
  5. Investing growths; with serum coagulable, tinged with blood and containing cholesterine:—
    a. Adenoid growths.
    b. Granulation cell-growths.
    c. Cancer.

1. We have already described, under the name *galactocele*, a tumour observed during suckling and composed of milk. But the surgeon is occasionally consulted about a swelling which, at first sight, would seem to have no reference to that function. Nevertheless the milk, or all that remains of that secretion, constitutes its entire bulk. If exact inquiry be made, the patient states that a tumour has existed, unaccompanied by pain, from the period of the last weaning, perhaps not having been observed until the gland ceased to secrete, and that its size slowly diminished until a certain period, since which it has remained of unvarying bulk. This decrease is due to the absorption of the serum of the milk, whilst the solid parts remain. The cyst should be incised, the contents removed, and the wound should be drained.

Cysts containing the solid parts of the milk are sometimes associated with perfectly new growths of the glandular type.

2. True *sero-cysts*—that is to say, collections of serum circumscribed by a fibrous membrane—are frequently met with, and are most commonly associated with adenoid, granulation, and cancerous growths. They occur in the breasts of middle-aged women. The fluid which these cysts contain is sometimes quite clear, and of a yellow tint; at other times it is tinged with blood-colouring matter, and is turbid. It always contains some constituent coagulable by heat and the admixture of nitric acid. These are the exudation-cysts of the mammary gland.

3. Other cysts containing a fluid like serum, until its composition is carefully examined, are developed in the breast, and are probably associated immediately with the secreting part of the gland. For the sake of identification the writer would designate them *mucous cysts.* The contained fluid is not coagulable by either heat or acid. Its colour is brown, more or less inclining to a greenish hue, and is probably really that of altered milk; it is opalescent, of variable specific gravity—about 1020, rather greasy when rubbed between the fingers, and exhibits an alkaline reaction. When sufficient quantity is collected in a test-tube and allowed to cool, in a few hours the lowermost stratum of the fluid becomes clearer than the upper. The uppermost always remains opalescent. If a little of this last be examined with a microscope, oil-globules are seen, together with the bodies called colostrum cells. The greasy nature of the fluid can be detected by smearing a drop of it on a piece of glass.

The development of these cysts is not very common. We may here remark that they seem to have escaped the observation of surgeons, as no special notice of them occurs in the most recent monographs. Yet they are so distinctly separated from all the other cysts which are formed in the breast, in respect of the composition of their fluid contents, their progress, and their prognosis, that they constitute a marked, distinct, and isolated class. We meet with them in the breasts of single women, in married but sterile females, and in widows between forty and fifty years of age. Usually they are accidentally discovered in any quarter of the gland when about an inch in diameter. Their shape is globular or ovoid; to the touch elasticity is the main feature, and if sufficiently large and superficial, fluctuation may be detected. In some instances the tips of the fingers may be insinuated into a sort of furrow around them. Pain is rarely complained of. The treatment consists in emptying the cyst with a trocar and cannula. After this the fluid does not again form. These cysts usually appear singly and in one breast only, but the writer has seen a patient in whom they were multiple and on both sides.

4. Cysts containing blood—*hæmatomata*—are very rarely formed in the breast, except in association with some new-growth from which blood, or more often bloody serum, oozes. They may, however, occasionally occur independently of any new-growth.

5. True *entozoa-cysts* are developed in the breast. They are certainly rare, and cannot be distinguished from other cysts until incised. Extirpation by excision is the speediest means of effecting a cure.

6. Sebaceous cysts are occasionally met with in this region.

B. **Solid Tumours.**—We have next to describe the solid tumours. These are essentially new-growths of tissue superadded to the normal gland. Generally, therefore, a characteristic feature of the existence of such growths is an increased bulk of the affected organ; another, the firmness or resistance to pressure with the fingers when contrasted with the group of tumours before described. The solid tumours have long been classed in regard to their local and constitutional effects, and their results on the life of the individual affected with them, into two groups—the *innocent* or harmless; and the *malignant* or life-destroying.

1. *Adenoma.*—In the first class are placed the growths more or less closely resembling in their tissues those composing the glandular structure of the breast. Various terms have been assigned to these tumours, namely, Chronic Mammary Tumours, Pancreatic Sarcoma, *Tumeur adénoïde*, *Corps fibreux*, *Hypertrophie partielle*, Mammary Glandular Tumour, Fibroma, Adenocele. Their composition is chiefly fibrous tissue; the cæci or acini of secreting structures, with more or less distinctly marked traces of ducts, being interspersed throughout the mass. *See* TUMOURS: Adenoma.

Adenomata are developed in the breasts of young, unmarried women from the age of puberty upwards; rarely after thirty, but very commonly before that age. They may be intraglandular, occupying the substance or body of the gland, and having the normal gland-tissue investing them. In other instances they seem to be attached by a kind of pedicle either to its surface or margin. In every instance they are placed within the fascial investment of the organ. When attached, as just described, their remarkable mobility, slight lobulation of surface, and firmness, coupled with the youth of the patient, are sufficient indications of the harmlessness of their nature. Usually they occur singly and in one breast; they may be multiple and in both breasts. The only means by which they can be removed is excision. However large the tumour, its removal should be always attempted without cutting away any portion of the normal breast. In most cases this can be done, especially if the patient be youthful and the growth of medium size, even should it be developed in the body of the gland and extend through it to the pectoral muscle. After thirty-five years of age it is expedient to remove the breast as well. For these tumours, especially those which may be called soft adenoids, approach very closely to the cancers (*see* TUMOURS). A section shows a solid, uniform surface, divided into lobes and lobules by fibrous septa, sometimes slightly broken up by fissures or clefts in which there appears a little clear tenacious fluid. The growth is often very succulent, at other times only moist; its hue may be greyish, yellow, or almost white. Its vascularity is scarcely perceptible. The prognosis of these cases is invariably favourable.

2. *Fatty tumour.*—Lipomata or masses of adipose tissue are developed in the breast, or rather in relation with it, to speak with accuracy. They are characterised by the usual indications, and require no special mention.

3. *Nævus.*—It may be questioned whether nævus, or a growth of true trabecular vascular fibre-tissue, is ever developed in the substance of the breast, that is to say, in the gland-tissue, although the integument around the mammilla may certainly be so affected in early life before the development of the gland, and a subcutaneous nævus may exist at the site of the future organ.

4. *Sarcoma.*—Under this heading, as well as that formerly employed of 'fibroplastic tumour,' we include a group of new-growths composed of more or less well developed sarcoma tissue, in which are interspersed somewhat modified acini and ducts of the gland. They are developed in women of middle age, increase rapidly, and after excision are liable to grow again. They usually require complete removal of the breast.

5. *Colloid.*—Colloid growths are occasionally met with in the breast. They are true cancers which have undergone the usual colloid degeneration; and they must be treated on the same lines. They appear in middle life, and are not distinguishable from other solid tumours until after excision.

6. *Carcinoma.* — Carcinoma, commonly called cancer, is developed in the breast in two distinct forms. The first, and most common, is that variety which is due to infiltration of the normal tissues of the gland by the elementary cells of cancer. It constitutes the *scirrhous* variety. The second is that kind which is produced by the development of a mass of *soft*, *medullary* or *encephaloid* cancer-growth. Both varieties are met with in women after forty years of age, but the first much the most frequently. Previously to that age the disease is rare; from forty to fifty it is most commonly seen; and it becomes relatively less frequent as age advances. A larger number of married women are affected by it than single, and prolific women who have suckled their children are quite as prone to the disease as the sterile or those who have not suckled. For the histological structure *see* CANCER.

SYMPTOMS.—*Scirrhous* cancer commences in any region of the mammary gland, although most frequently perhaps in the axillary segment. A small, firm nodule is usually accidentally discovered, without the attention of the patient having been attracted to it by pain. Rarely, the whole organ is simultaneously infiltrated, but most frequently one lobe only is affected. The infiltration is often central in the body of the gland, especially when the organ is atrophied, and the reverse occurs when the extreme edge of a lobe is affected at its periphery. The infiltration may steadily increase until the whole breast forms a rigid, solid mass; but most frequently the larger part of the organ remains unaffected. The disease gives rise by its contraction to much deformity of the region, to dimpling, corrugation, and irregularities of the otherwise rotund integumental surface. The nipple, just in proportion to the effect of the growth upon the ducts, becomes retracted or drawn towards the tumour. Such are the ordinary objective signs of infiltrating cancer in its early stage. The progress made by the disease is subject to very remarkable variations in different individuals, and the stage above described may be long delayed. In some cases many months or even years may elapse before the growth assumes any grave importance. Sooner or later, however, the integument over the growth becomes adherent to it, infiltrated, and red, and advances towards ulceration. An ulcer now forms, the edges of which are everted, ragged, and attached to the growth beneath. A hole extending into the tumour becomes deeper and deeper; ichorous discharges, more or less profuse, continue without much pain; and the patient becomes at last worn-out, or succumbs to the ravages of a cancerous growth in a vital organ.

The *encephaloid* variety commences in a small, circumscribed, globular nodule in the body of the gland; grows rapidly; separates the lobes of the organ; extends equally in all directions; and becomes adherent to the skin, which commonly sloughs and allows of a protruding, fungating mass.

In both varieties the axillary lymphatic glands sooner or later become involved in the disease, which may also spread to those in the neck and within the thorax.

TREATMENT.—Local applications exert little if any influence on the growth of cancer. The vital powers of the patient should be supported as much as possible by hygienic measures, and especially by ferruginous tonics. The removal of the primary growth before the contamination of the lymphatic system is of great importance; and the methodical removal of the axillary glands is to be strongly recommended. If the case have advanced too far for operative interference, and an open sore have formed, suitable antiseptic remedies must be employed.

C. **Mixed Tumours.**—To the group of mixed tumours belong:—1. Those composed of cysts, intracystic growths, and solid interspersed masses of new tissue. 2. *Granulation cysts*—cysts with growths attached to their walls, the elementary tissues of which resemble those of ordinary granulation-growths—whence the term applied to them. 3. Cysts, so called, often formed upon the surface of cancers, in consequence of the slow exudation of serum from the growth itself.

1. Tumours of the first class belong pathologically to the group of adenoid formations, and although they differ so remarkably in their external objective appearances, they are, when unalloyed with other growths, perfectly harmless. The sero-cystic disease of Brodie, and the proliferous cysts of Paget belong to this class.

2. The *granulation-cystic* growths constitute a class of themselves. It is only of late years that attention has been attracted to them. They are rarely met with, and when pure are unattended by untoward circumstances.

3. To the third class belongs a group of cases thoroughly cancerous in their nature, and differing only from the ordinary forms of that disease by the accidental formation of cysts. *See* TUMOURS.

III. Diseases of the Male Breast.—The male has sometimes a well-developed mammary gland, and the part is subject to the same diseases as the female. But the simple enlargement of the organ is harmless, and should not be interfered with. At the age of puberty the mammary region often becomes painful, owing in part to the pressure of the dress upon the mammilla and the rudimentary organ. Inflammation followed by suppuration has been observed at this time.

IV. Diseases of the Nipple.—A *defective formation* of the nipple is of grave importance, and when it exists measures should be adopted to assist its elongation. This is to be done by using an exhausting-glass, such as those employed to empty the gland of milk.

Inflammation and its effects produce much suffering, and at the period of suckling frequently excite deep-seated mischief. The small ulcers, called 'cracks,' 'chaps,' &c., which form between the rugæ on the apex and sides of the nipple, may be cured with an application of water-dressing, or by powdering the part with carbonate of magnesium or oxide of zinc, or with a weak solution of carbolic acid. Sir James Paget has described a chronic eczema of the nipple which may assume a malignant character.

Pendulous cutaneous growths occur on the nipple, and should be excised.

Cystic follicular tumours are sometimes seen within the zone of the areola. *See* NIPPLE, Diseases of.

JOHN BIRKETT.

BREATH, The.—The expired air, or what is familiarly termed *the breath*, is important both from an ætiological and a clinical point of view, and the object of the present article is to present a brief summary of the main facts relating to this subject, with which, for practical purposes, it is necessary to be acquainted.

1. The **ætiological** relations of the expired air will be more appropriately discussed in detail under the general subject of ætiology (*see* DISEASE, Causes of), but a few of the more striking examples of the manner in which it affects the health may be given here. It is well known that the expired air, if re-breathed by the same individual without having been purified by a proper admixture with atmospheric air, will produce serious effects upon the economy, and will ultimately lead to death by asphyxia. Again, the breath of a number of persons collected together in an ill-ventilated place may prove injurious to such individuals; the impure atmosphere thus generated tends to lower the general health, to retard the development of the young, to increase the virulence of infectious diseases, and to predispose to pulmonary affections. Indeed, some writers regard re-breathed air as one of the most prominent causes of pulmonary phthisis. Further, undoubtedly the expired air is a most important channel by which the poison of certain infective diseases—for example, that of measles, scarlatina, or diphtheria—is conveyed from one individual to another. It has been affirmed that phthisis can be transmitted directly in this manner, but adequate proof of this statement is entirely wanting.

2. From a **clinical** point of view, the breath may afford useful information in diagnosis; or it may present characters giving important indications for prognosis and treatment. It might be requisite in different cases to submit the expired air to a more or less systematic examination, and the following outline will serve to suggest the particulars to which attention should be directed in this examination, and to point out the practical uses which it may serve.

a. The breath has been made use of to distinguish between *real* and *apparent death*. For this purpose a delicate feather or a light is held before the mouth or nostrils, and it is noted whether either of these is disturbed; or a cold mirror is placed before the mouth, when, if breathing is going on, its surface will be clouded by the moisture condensed upon it. These tests are, however, not considered very reliable.

b. The *temperature* of the expired air may be important to notice. In some conditions it becomes exceedingly cold, and this may be readily perceptible to the hand, the breath having a chill feel, or it may be visible in consequence of the moisture in the expired air being condensed, even when the surrounding atmosphere is warm. The phenomenon is observed, for instance, in the collapse-stage of cholera. On the other hand, the temperature of the breath may be raised more or less, as in febrile diseases.

c. Chemical examination of the breath may prove of service, and it is probable that this might afford useful information, if it were resorted to more frequently than is the custom at present. In the first place, this examination may be employed to determine the proportion of carbonic acid present. In certain affections, as during an attack of asthma, or in cases of extensive bronchitis, the amount of carbonic acid in the expired air is more or less increased; in others, such as in the collapse-stage of cholera, this constituent may be very deficient. Again, chemical examination of the breath may reveal the presence of a poison in the system, introduced from without, for example, hydrocyanic acid. It has also been employed to show the existence of deleterious products generated within the body, especially in cases of renal disease. It is affirmed that ammonia may be detected in the breath in some cases of this kind, by holding a glass rod dipped in hydrochloric acid before the mouth, the ammonia being a product of the decomposition of urea.

d. Microscopical examination of the expired air has been attempted, but at present no results of practical value have been obtained, although it has been affirmed that tubercle-bacilli have been found in it in cases of pulmonary phthisis.

e. The odour of the breath is the most important character demanding attention from a practical point of view. It is easily recognised, and the practitioner should always be on the alert to notice the smell of the breath of a patient, as this often affords material aid in diagnosis, and may even reveal certain morbid conditions which otherwise are liable to be entirely overlooked. Besides, patients not uncommonly seek advice on account of 'foulness of breath,' as a symptom for which they require special treatment. The following summary will indicate the principal circumstances under which this clinical phenomenon may prove of service in diagnosis, and in the course of the remarks it will be pointed out in what conditions the breath is particularly offensive. At the outset it must be observed that in some individuals the breath seems to have naturally a more or less disagreeable odour, which cannot be referred to any particular cause, and this amounts occasionally to extreme foulness. In females this may only be noticed at certain periods, and in some instances it seems to pass off in course of time. Again, it must be borne in mind that the breath is frequently unpleasant, either temporarily or constantly, owing to persons eating certain articles of food, or indulging in certain habits, such as excessive smoking, or chewing tobacco.

(i.) The odour of the expired air may aid in recognising poisons in the system. The smell of prussic acid or laudanum, for instance, may be revealed when either of these is present in the stomach. Alcohol, however, chiefly demands attention in this relationship. In cases of acute alcoholic poisoning, the odour of the alcohol or of its products is at once apparent; and in persons who are found in a state of unconsciousness, the cause of which is not known, the smell of the breath is made use of as one of the diagnostic signs of drunkenness, though it must be taken with great caution. It is in the chronic forms of alcoholism that the breath gives the most valuable information. In very marked cases of chronic alcoholism it has an intensely foul odour, which is quite characteristic; but it gives extremely important indications in less confirmed cases, where the other symptoms of alcoholism are not so apparent; and especially does it enable us to detect dram-drinkers, and to explain the symptoms of which they so frequently complain. These persons, if their habits are inquired into, generally give themselves an excellent character for temperance, and seem entirely to forget that those with whom they come into contact are endowed with the sense of smell. Again, the breath may reveal the presence of certain metallic poisons in the system, of which mercury is the most important example, but lead may also affect its odour. The expired air presents the odour of ammonia in exceptional instances of uræmia, due to the exhalation of carbonate of ammonium, derived from the decomposition of urea. In cases of diabetes, and especially diabetic coma, the breath may have a sweetish, fragrant, or ethereal odour, attributed to acetone.

(ii.) The breath has a peculiar, or more or less disagreeable odour, in connexion with several diseases. That which is associated with the febrile condition is well known. In various disorders of the digestive organs the breath is often very offensive, but it is not practicable to refer any particular odour to particular diseases of either of these organs; it may, however, be affirmed that an unpleasant smell is frequently associated with habitual constipation. In cases of stercoraceous vomiting the breath may have a distinctly fæcal odour. In this relation it may be mentioned that in some cases of phthisis the writer has noticed a sickly smell of the breath which is quite characteristic, and which seems to depend upon the state of the stomach. In cases of cerebral disease also, the breath often becomes exceedingly offensive, on account of the condition of the alimentary canal. Local morbid conditions about the mouth, throat, or nasal cavities constitute a most important class of affections which influence the odour of the breath; in many cases it becomes extremely foul, and may be quite peculiar in its characters. Among these conditions should be specially mentioned want of cleanliness of the mouth and teeth; decayed teeth; diseased bone in the mouth or nose; ulceration or gangrene about the mouth, especially cancrum oris, and gangrenous ulceration along the gums; suppuration, ulceration, or gangrene in the throat, either of local origin, or associated with syphilis, scarlatina, diphtheria, or other general diseases; ulceration of the nasal mucous membrane, and chronic ozæna; and malignant disease. The smell of the breath is of special value in drawing attention to some of these conditions, for they may exist without giving rise to any local symptoms whatever, and the patient may be quite unconscious that there is anything wrong. Several striking illustrations of this statement have come under the writer's observation. Again, certain conditions of the respiratory organs are liable to affect the odour of the expired air, and may render it unbearably fœtid. Among these may be mentioned sloughing ulceration about the larynx, pulmonary gangrene in any form, and the decomposition of retained morbid products in dilated bronchial tubes or in certain cavities. Here, again, the smell of the expired air may reveal what otherwise is liable to be entirely overlooked, and especially when the patient coughs, so as to expel some of the retained air out of the lungs. Lastly, the breath may have a peculiar odour in some special diseases, such as pyæmia and its allies.

TREATMENT.—It is only intended here to offer a few remarks as to the treatment of *foulness of breath.* The first great indication is, of course, to seek out the cause of this symptom, and endeavour to remove or remedy this, by which in a large proportion of cases a cure may be readily effected. The habits should be duly regulated; the mouth and teeth properly cleansed; the alimentary canal maintained in good order; and any special affection requiring treatment attended to. When unpleasant breath depends on the stomach, it may often be improved by taking charcoal powder or biscuits, at the same time remedies being employed suitable for the particular affection present, and calculated to promote the functions of the alimentary canal, the bowels being also kept freely open. When the bad smell depends on local causes, it may be diminished by the use of antiseptic mouthwashes, gargles, sprays, or nasal douches, of Condy's fluid, carbolic acid, or creasote. Antiseptic inhalations are indicated in fœtor from the air-tubes. FREDERICK T. ROBERTS.

BRIDES-LES-BAINS, in Savoy.—Thermal alkaline saline waters. *See* MINERAL WATERS.

BRIGHT'S DISEASE.—SYNON.: Fr. *Maladie de Bright*; Ger. *Die Bright'sche Krankheit.*

The term *Bright's Disease* is now recognised as generic, and as including several diseases of the kidney. Many writers recognise at least three varieties,[1] each of which involves chiefly one of the individual structural elements of the organ, and only secondarily, or in a minor degree, affects the others. There are thus morbid processes affecting mainly the uriniferous tubules, the fibrous stroma, and the blood-vessels, particularly those of the Malpighian tufts. That which originates in the tubules is always inflammatory in its character, although the inflammation may be *acute* or *chronic*, and may to a greater or less extent affect the stroma; that which is proper to the stroma is an extremely chronic process, supposed by many to be inflammatory, but as it appears to others, rather of an hypertrophic character; that which commences in the vessels consists in a peculiar degenerative change, the so-called waxy, lardaceous, albuminoid, or amyloid degeneration. In the following article are described:—

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[1] Dr. Quain was the first to describe three forms of Bright's disease: first, the granular or atrophied

I. The *inflammatory affection*, affecting the tubules, or the stroma, or both.

II. The *cirrhotic* or *gouty affection*, originating in the fibrous stroma.

III. The *waxy* or *amyloid affection*, originating in the vessels.

Definitions.—I. *Inflammatory Bright's disease* is an acute or chronic affection of the kidney; caused by exposure to cold, and by scarlatinal and other blood-poisons; consisting in inflammation of the elements, passing through various stages of transformation, viz. inflammatory enlargement, fatty degeneration, and atrophy; characterised in the earlier stages by diminution of urine, albuminuria, frequently hæmaturia, tube-casts, and dropsy; in the later stages by the same symptoms, in a more or less marked degree, with secondary changes in the heart, blood-vessels, and other organs; terminating frequently in recovery in the early stage, rarely in the later, often in death by dropsy, uræmia, or intercurrent affections.

II. *Cirrhotic Bright's disease* is a chronic affection of the kidney, caused generally by the abuse of alcohol, sometimes by the poison of gout, occasionally by plumbism, and by unknown conditions; consisting in increase of the fibrous stroma, with thickening of the capsule, and ultimate atrophy of the organ; characterised by a very insidious commencement, by the absence of the early symptoms of either of the other forms, by albuminuria, at first slight or only occasionally present, afterwards more pronounced, and by the ultimate appearance of enlargement of the heart, tension of pulse, sclerosis of arteries, polyuria, albuminuric retinitis, œdema of the lungs, and uræmia; resulting ultimately in death, from uræmia, œdema of the lungs, or other intercurrent affections.

III. *Waxy Bright's disease* is a chronic affection of the kidney, caused by phthisis, syphilis, caries, suppuration, and other exhausting conditions; consisting in waxy or amyloid degeneration of the Malpighian bodies, small arteries, and sometimes the basement membrane, with, in many cases, transudation into the tubules; passing through various stages of transformation, viz. simple degeneration, enlargement from transudation, and atrophy; characterised by a large flow of albuminous urine of low specific gravity, and absence of dropsy; often attended by evidences of waxy disease of other organs, particularly the liver, spleen, and intestinal canal; resulting probably in some cases in recovery, usually in death by exhaustion, uræmia, or co-existing affections of the kidneys and other organs.

Ætiology.—I. Of the *inflammatory form*. Cold is the commonest cause in the adult. It acts especially on those who have been exposed to its influence whilst perspiring. It frequently contributes towards the production of the disease in persons otherwise predisposed. Various blood-diseases, while they induce temporary albuminuria along with their more ordinary symptoms, have renal inflammation as a common sequela. Among these scarlatina occupies the first place, diphtheria stands next in order, followed by erysipelas, measles, pyæmia, typhus, ague, acute rheumatism, and pneumonia. Many of these maladies being most common in childhood, it follows that in the earlier years of life they are the chief causes of inflammatory Bright's disease. Pregnancy, heart-disease, gout, and malaria contribute towards its production in some cases; and the undue use of cantharides, turpentine, or alcohol may also be reckoned as causes.

II. Of the *cirrhotic form*. The commonest cause is the abuse of alcohol, particularly in the form of ardent spirits. After this, though at a long interval, rank gout and lead-poisoning. Congestion from cardiac disease is also by many authorities, but erroneously, held to be a cause (*see* Kidneys, Congestion of). As experience shows that the disease is often met with in people who have neither indulged in alcohol, been exposed to lead, nor suffered from gout, it is obvious that other efficient, though as yet undiscovered, causes must exist. Some authorities believe that true cirrhosis is also frequently a result of acute interstitial inflammation, and that this process is thus referable to cold, scarlatina, and other causes.

III. Of the *waxy form*. Constitutional syphilis, phthisis, prolonged suppuration, caries or necrosis of bone, and other exhausting diseases, such as cancer and chronic rheumatism, induce this degeneration. There is at present no satisfactory evidence as to the precise connexion between these influences and the morbid process.

Anatomical Characters.—I. Of the *inflammatory form*. When a case of this kind is prolonged, the renal disease passes

kidney; second, the enlarged, amyloid kidney; and third, the fatty kidney.—*Lancet*, November, 1845.

through several conditions, which, for convenience of description, may be divided into three stages. (*a*) *Stage of active inflammation.* In this stage the kidney is enlarged; its capsule strips off readily; its surface appears more or less red, sometimes of a deep purple colour; and occasionally extravasations of blood are present in its substance. On section the cortical substance is found to be relatively increased in bulk. Its vessels, as well as those of the cones, are congested. The structure appears somewhat coarser than natural, while the convoluted tubules often present a swollen, opaque appearance, and occasionally contain blood. On microscopic examination the congestion of the vessels becomes very apparent, and the tubules are found to be dark and opaque, their lumen being frequently occluded. The individual epithelial cells are granular, and in a state of cloudy swelling. In some cases almost all the tubules appear affected, in others comparatively few. The enlargement of the organ is in part due to congestion, in part to exudation into the tubules. As the exudation increases the congestion becomes less marked, so that in the later period of this stage the kidney appears paler and more opaque. Unless recovery or death takes place, this condition passes into (*b*) The *second stage*, that of *fatty transformation.* In this stage the organ is still enlarged. Its capsule strips off readily; the surface often presents stellate veins, and its colour is mottled. At this time extravasations are very rarely observed, but there are alternating patches of yellowish opaque sebaceous-looking material, mingled with more natural structure. On section the cortical substance is seen to be relatively increased. There is no congestion of the vessels, and the Malpighian bodies are not prominent. The convoluted tubules are in many parts occupied by the sebum-like material, and sometimes the straight tubules present the same appearance. On microscopic examination the tubules alone are found affected. Many of them present under low powers a black appearance, due to fatty degeneration of the contents of the tubules. It is in the cells alone that this change occurs, and not, so far as the writer has seen, in the free exudation which binds the cells together. Many of the tubules are completely blocked up by this material; and sometimes in making the section of the recent kidney there is such an amount of oil set free that it permeates the whole structure of the organ, and is liable to produce the impression that the fatty degeneration is universal. This condition may be developed within a week or two of the commencement of the inflammation, and it may continue for years. During the whole course of the second stage it must be understood that inflammatory action is going on, although much less acutely than at first, and less widely diffused. The disease is sometimes recovered from, but, more commonly, it persists; and if the patient survive long enough, it passes into (*c*) The *third stage*, that of *atrophy.* The organ is then reduced to or even below the natural size. Its capsule strips off with little difficulty, and without tearing the surface. The surface is uneven; it rarely appears coarsely granular, as in the cirrhotic form, but rather presents a series of depressions, which give it an uneven or finely granular character. Its colour is very similar to that described as occurring in the second stage, but there is less of the sebaceous-looking material. On section the cortical substance is found relatively diminished. The Malpighian bodies are not prominent. The tissue feels more dense, and many of the tubules are occupied by sebaceous-looking material. The blood-vessels, and particularly the small arteries, are sclerosed: the intima and the adventitia are frequently, the middle coat almost invariably, thickened. The fibrous stroma is relatively increased, especially towards the surface of the organ, and the tubules may be traced in different stages of atrophy. On close inspection that atrophy is found to result not so much from shrinking of the fibrous stroma as from molecular absorption of the contents of the tubules.

Besides the typical form of the inflammatory affection just described, a very common variety is the form of post-scarlatinal inflammation first accurately described by Klebs, to which he has given the name *glomerulo-nephritis*, because the glomeruli are especially affected. In this condition an accumulation of round cells (leucocytes) takes place in the glomeruli and neighbouring connective tissue, while blood is frequently extravasated within the glomeruli between the tufts of vessels and the capsule, as well as into the tubules. In the tubules also more or less inflammatory action manifests itself in the epithelium, and the corresponding structures of the Malpighian bodies suffer in a greater degree. At times the accumulation and swelling of these structures is sufficient to compress the vascular tuft. This disease also may be described as passing through three stages—in the first of which there is some enlargement with minute extravasations and the microscopic changes above described; in the second, where a fatty transformation has occurred in the epithelium and the fibrous tissues show thickening; in the third there is more or less atrophy, with shrinking of tubules or morbid increase of the fibrous stroma.

The anatomical changes met with in other organs are described along with the complications.

II. Of the *cirrhotic form.* The course of this affection is very chronic. It consists essentially in an increased growth of the fibrous stroma, with secondary changes in the tubules and vessels. In an early stage the organ may be found of fully the natural size. The capsule strips off less readily than in health. The surface is somewhat uneven, and may present cysts. On section the cortical substance is relatively enlarged, and this is due merely to an increase of the stroma, not to any change in the vessels or in the tubules. But it is in the more advanced stages that the disease is commonly seen. Then the organ is reduced in bulk, it may be slightly, it may be to one-fourth of its normal size. Its capsule cannot be peeled off without tearing the gland. The surface is uneven and granular, and often of a reddish colour. On section the cortical substance is found relatively diminished, its structure being dense and fibrous. The small arteries are thickened and very prominent, all their coats, but especially the middle, being increased in volume. Many of the tubules are atrophied, but the epithelium of such as are not involved is for the most part natural. Cysts are numerous, and are found in connexion with the tubules, the Malpighian bodies, and the cells.

There are two points worthy of being specially kept in view by those who desire to attain to clear conceptions of Bright's disease —viz. (1) That its different forms are very frequently combined—in particular that the inflammatory affection is found associated sometimes with the waxy disease, sometimes with the cirrhotic; but that the descriptions here given are derived from pure examples of each process; and (2) that atrophy results in all the forms if the disease lasts long enough; that is, that a small, uneven-surfaced kidney may result from either the inflammatory disease of the tubules, or the waxy disease of the vessels, as well as from the increased growth and subsequent contraction of the fibrous stroma in the cirrhotic form.

III. Of the *waxy* or *amyloid form.* This chronic morbid process may also, for convenience of description, be divided into three stages. Of these the first is (*a*) *The stage of degeneration proper*, in which the organ presents an almost normal appearance. The size is natural; the capsule strips off readily; and the colour is not altered. On section all appears normal, excepting that the Malpighian tufts, without being congested, are prominent, and in certain lights may be seen, even by the naked eye, to present the dim translucency characteristic of waxy degeneration. On applying a little aqueous solution of iodine, the Malpighian tufts and the small arteries assume a peculiar mahogany hue. On examination with the microscope, the stroma and tubules are found to be healthy, the vascular structures being alone affected. The affection is often first seen and is most distinct in the middle coat of the arteries, the swollen transverse fibres taking on the colour, and producing what has been described as the ipecacuanha-root appearance. How long this condition may last without the tubules becoming affected it is impossible at present to say, for it has only been met with in patients who had died of one or other of the causal complications while the renal malady was still in an early stage. Sooner or later it passes, however, into the condition most commonly met with—(*b*) the *second stage*, that of *degeneration with secondary changes in the tubules.* In this condition the organ is enlarged. Its capsule strips off readily, the surface is smooth and pale, presenting, in pure examples, little or no mottling. On section the cortical substance appears relatively increased, and looks much paler than the cones. The structure usually is denser than natural. The vessels appear prominent, and the Malpighian tufts resemble minute grains of boiled sago. On the addition of iodine the degenerated parts become characteristically coloured, and stand out prominently from the tubular tissue, which does not exhibit the characteristic reaction. On microscopic examination the vessels are found altered as in the earlier stage, but the change is more advanced. The stroma is normal, but many of the tubules are altered. Some are blocked up by a dimly translucent, wax-like material, which however does not assume the mahogany colour on the addition of iodine. The epithelium in many of the tubules presents a finely granular appearance, and occasionally is somewhat fatty, but the epithelium and the basement membrane very rarely present the characteristic reaction. This change in the tubules is thus secondary to the degeneration proper, which is confined to the vessels; and these secondary changes consist in some alteration of the nutrition of the epithelium, with exudation or transudation of coagulable material into the lumen of the tubes. This condition may last for years, but should the patient live long enough it passes into (*c*) the *third stage*, that of *atrophy.* The organ is then below the normal size; the capsule strips off readily; the surface presents an uneven granular appearance, and is pale. On section the cortical substance is found relatively diminished. Its small arteries are prominent and thickened; its Malpighian bodies are very conspicuous, and are grouped together in consequence of the atrophy of the intervening structure. The stroma is relatively increased, and many of the tubules are destroyed, while of those which remain not a few present the characters above described as being met with in the second stage. The organ may, in extreme cases, be diminished to less than half its natural size.

SYMPTOMS.—1. *Of the inflammatory form.* The leading clinical features of this variety, in addition to the albuminuria which exists in all the forms of Bright's disease, are diminution in the quantity of urine, and the presence of dropsy.

The onset of the disease may be sudden or gradual. Sometimes it is the diminution and alteration of the urine that attracts attention, sometimes the dropsy, sometimes the gastric derangement and general uneasiness; but whichever symptom may appear first, the others usually speedily follow. The urine is generally diminished in quantity, often somewhat opaque, and smoky or even bloody. It contains much albumin and numerous tube-casts. The casts are granular, being composed mostly of epithelium in a state of cloudy swelling; sometimes bloody; frequently hyaline or fibrinous. The urea is diminished, it may be, to one-half, one-fourth, or even a less proportion of the natural amount. This leads to a corresponding reduction of the specific gravity, unless there be a compensatory diminution of water, or increase of albumin. The dropsy is generally distinct in the face, and swelling of the eyelids is well-marked in the morning. Towards evening, if the patient be out of bed, the legs are chiefly affected. The scrotum and penis are often swollen, and sometimes the abdomen is also dropsical. There is little quickening of pulse or elevation of temperature, but a good deal of general uneasiness is experienced, with debility and pain in the loins; and dyspeptic symptoms are often present, due to gastric catarrh. Such is the usual condition at the commencement of the disease, and during the period which has been already described as the first stage. But sometimes at this stage a much more serious condition is developed—namely, suppression of urine, followed by coma or convulsions leading to a fatal result; or dropsy may increase to such an extent as of itself to cause death. Or, again, without or even with the most unfavourable symptoms, under appropriate treatment the kidneys may begin to act more freely, the urine increasing in amount and improving in characters, with consequent gradual disappearance of the dropsy, and restoration of health. Or, as often happens, the general condition improves, but a chronic albuminuria remains, and the disease passes into the second stage. The urine is then no longer bloody; the quantity is greater, though still below the normal; the specific gravity is low; there is albumin, along with tube-casts, fatty, hyaline, or mixed, partly fatty and partly hyaline. The urea is below the normal standard. The dropsy may continue, and may even gradually increase, or it may pass off and only appear when the patient is fatigued, or when he has caught cold. The general symptoms remain unchanged, except that anæmia comes on, and the patient's debility steadily increases. This course of events may pass on to a fatal result; or there may be complete, or, as is more common, merely partial recovery. In this condition the patient may linger for many months, occasionally suffering exacerbations, and he may succumb to one of them, or to one of the numerous complications to be presently described. If the patient passes into the third stage, he appears prematurely old. His urine is of natural amount or even somewhat increased in quantity, but of low specific gravity. It contains albumin and a few casts, mostly hyaline, with scattered fatty cells imbedded in them. The urea is still diminished. There is dropsy of the feet and ankles in the evenings, and slight exposure brings on more general attacks. The face is pale and pasty, and the eyelids are often œdematous. The pulse becomes hard and tense; the arteries gradually become thickened from sclerosis and atheroma; while the apex-beat of the heart passes downwards and to the left side, owing to hypertrophy, particularly of the left ventricle. In this condition a fatal result may be induced by an acute exacerbation with general dropsy; by chronic, or, more rarely, acute uræmia; or by intercurrent attacks of inflammatory or other affections of various organs.

Glomerulo-nephritis is perhaps attended with a greater tendency to hæmaturia, and less tendency to dropsy, than other forms of acute nephritis, but the clinical features are not as yet capable of being definitely marked off from those of other maladies. Dr. George Johnson has drawn attention to a peculiar kind of cast, containing numerous leucocytes which characterise this particular lesion.

2. *Of the cirrhotic disease.* The onset of this affection is extremely insidious, and it may exist for a long time without distinctly manifesting itself by symptoms. Its existence may be suspected when a patient suffers from renal inadequacy in respect that the urea-discharge falls below the normal standard, and albumin occasionally appears in the urine, but one is not entitled to establish a diagnosis upon such grounds alone. The condition is often discovered only when dyspepsia, uræmic convulsions, or blindness from retinitis leads the patient to consult a medical man. The earliest symptoms are occasional slight albuminuria, and frequent calls to micturition during the night, the urine however not being excessive, its specific gravity being low, and the urea somewhat diminished. But when the disease has existed for some time the complexion becomes altered; the eye assumes a peculiar appearance, from œdema of the conjunctiva; the patient is subject to dyspeptic attacks: the heart becomes hypertrophied, and the vessels sclerosed and degenerated; while there is little or no dropsy. When the disease is advanced, these changes in the circulatory organs are well-marked, and the cachectic condition becomes distinct. The occurrence of various complications, such as severe gastric catarrh, diarrhœa, anæmia,

dyspnœa, bronchitis, œdema of the lungs, headache, uræmia, and the characteristic retinal affection, render the diagnosis easy. Frequently towards the end there is an increased flow of urine, of low specific gravity. This is in some cases a very prominent symptom. The disease is never recovered from, and the fatal result occurs from uræmia; from some inflammatory complication, such as pleurisy, pericarditis, bronchitis, or pneumonia; or from some result of degenerative change, as hæmorrhage from a mucous surface or into the brain.

3. *Of the waxy disease.* The onset of this affection is gradual and insidious. A patient who has suffered from phthisis, syphilis, or other wasting malady passes an excessive quantity of urine, and finds himself obliged to rise several times during the night for micturition. The urine is pale, of low specific gravity, containing at first no albumin, subsequently only a trace, ultimately a considerable amount. The urea is little, if at all, diminished; the tube-casts are extremely few, and mostly hyaline. There is no dropsy, but evidence of concomitant waxy affections of other organs is frequently afforded. The liver is enlarged, its margin being easily felt and sharply-defined. The spleen is also increased in size. The blood is slightly altered, the white corpuscles being somewhat increased, and the red being rather flabby and ill-defined. These conditions gradually become more distinct, and the strength of the patient diminishes, partly from the disease of the kidneys and other organs, partly from the wasting diseases which have induced the degenerative changes. A case of the kind has been known to go on for nearly ten years, during which time the urine continued of the characters just described, and dropsy never appeared. At length the vital powers of the patient became depressed, head symptoms gradually supervened, and death ensued. It is not often that such an uncomplicated case is met with. More commonly the exhausting disease which led to the degeneration causes death before the waxy change has gone so far. Sometimes also intercurrent complications induce the fatal result. Clinical observation renders it probable that the kidneys, as well as the liver and spleen, may recover from their degeneration, in cases in which the causal malady has been got rid of.

Complications.—(*a*) **Complications connected with the Alimentary System.**

Gastric affections are met with in all the forms of Bright's disease. Catarrh of the stomach—acute, sub-acute, and chronic—is common to them all, and is characterised by an unusual tendency to nausea and vomiting. It is especially frequent during the first stage and in acute exacerbations of the inflammatory form, and is often a chief source of suffering during the most advanced stages. It is not uncommon during the whole course of the waxy form, but is most usually met with in the cirrhotic variety. So close indeed is the relationship between them, that in the management of cases of cirrhosis regard should constantly be had to the state of the stomach, and in no case of chronic gastric catarrh should the physician neglect to inquire into the state of the urine. This affection, when complicating the early stage of the inflammatory form, often owes its origin to the same cause as the kidney-affection itself. When complicating the later stages of the inflammatory, and any of the stages of the cirrhotic disease, the catarrh is probably a result of efforts at elimination of materials retained in the blood by the failure of the action of the kidneys. When occurring in the waxy form, it is frequently due in part to the existence of waxy degeneration of the vessels of the gastric mucous membrane. In the waxy disease we sometimes find blood mingled with the vomited matters, just as we find hæmorrhage in other organs when this degeneration exists.

Catarrh of the intcstine also occasionally occurs, sometimes producing an exhausting diarrhœa, especially in advanced inflammatory and cirrhotic cases; but it is along with the waxy disease that intestinal symptoms are most common. These are due to waxy degeneration, and consequent ulceration; or to ordinary tubercular disease of the intestine. Both of these affections induce diarrhœa, but there is evidence that not only may it thus occur, but that blood may also be discharged, although there be no ulceration recognisable by the naked eye.

Hepatic affections.—Functional derangements of the liver occur in the course of all the forms of Bright's disease. The chief organic changes are fatty degeneration, waxy degeneration, cirrhosis, and syphilitic affections. The first-named is not specially related to any of the forms. The waxy degeneration and the syphilitic affections are of course commonly met with as accompaniments of the waxy disease; whilst cirrhosis is occasionally associated with the cirrhotic kidney, and sometimes with the other forms.

Ascites is often seen as a manifestation of general dropsy in the inflammatory form of Bright's disease; and sometimes this is a prominent symptom in mixed forms, when waxy disease of the liver is associated with a waxy and slightly inflammatory condition of the kidneys.

Peritonitis, like inflammation of the other serous membranes—one of the most important classes of the complications of Bright's disease, is occasionally the cause of death in all the three forms. It may result from local affections, or from the state of the blood; and may be acute, severe, and therefore obvious, or so insidious as scarcely to attract attention.

(β) Complications connected with the Blood, or with the Lymphatic- and Blood-glands.

The *spleen* is usually unaffected in cases of inflammatory Bright's disease, except such as prove fatal in the earliest stage, and in which the spleen is affected in common with the kidney. In the waxy and cirrhotic forms corresponding lesions are frequent in this organ.

The *lymphatic glands* are rarely altered excepting in the waxy form, in which they are sometimes the seat of the waxy degeneration, sometimes of tubercular disease, or of strumous inflammation.

The *blood* itself is altered in its chemical composition. In the inflammatory form its density is diminished, the corpuscles and albumen being deficient, while the water is correspondingly increased. The quantity of urea is above the normal. In long-standing cases of waxy disease similar changes are found; and not infrequently there is a slight numerical increase of the white corpuscles, and flabbiness of the red blood-discs when the spleen is affected. In the cirrhotic form like alterations also occur.

Hæmorrhage is apt to occur in advanced stages, especially of the cirrhotic form. It may take place from the kidneys, or from the mucous membranes, particularly that of the nostrils. In the inflammatory affection hæmaturia is common in the early stage; in the waxy variety this symptom occasionally occurs, but rarely to a serious extent.

(γ) Complications affecting the Circulatory System.

Hypertrophy of the heart is almost always present in cases of advanced cirrhotic disease, and also in the advanced stages of the inflammatory affection. One may trace in patients the gradual development of this hypertrophy, advancing *pari passu* with the progress of the renal affection. It is comparatively rare in the waxy form. *Hydropericardium* is met with in some cases, as a manifestation of general dropsy. *Pericarditis* occurs as an intercurrent affection in all the forms, but especially the inflammatory and the cirrhotic. It is apt to be overlooked, owing to the absence of local pain, or from the pain being referred to the abdomen. *Endocarditis* is also frequently associated with the various forms of Bright's disease.

The *arteries* are sclerosed and atheromatous in the advanced stages of the inflammatory and in the cirrhotic, and to a less extent in the corresponding stage of the waxy disease. In that affection the small vessels in other parts are frequently the seat of waxy degeneration. Thickening of the arteries occurs constantly in the more advanced stages of the inflammatory and cirrhotic diseases, and is due in great part to hypertrophy of their middle coat, in lesser degree to sclerosis of the tunica intima, the tunica adventitia, and perhaps the perivascular lymphatic sheath. The *pulse* becomes tense and sustained in chronic cases, partly from the hypertrophy of the heart, partly from the changes in the capillaries and smaller arteries.

(δ) Complications connected with the Respiratory System.

Acute bronchitis is common, especially in the advanced stages of Bright's disease, and tends to pass into the chronic state. Bronchitis may originate also as a sub-acute or chronic affection. *Œdema of the lungs* is very common in advanced stages, and frequently occurs as a manifestation of general dropsy in the early, as well as in the later, stages of Bright's disease. It may be very suddenly developed in cirrhotic cases, and may rapidly prove fatal. *Pneumonia* occurs sometimes as a cause of inflammatory Bright's disease, sometimes as a consequence of exposure to cold during the course of chronic cases. *Phthisis* in its various forms is found causally associated with these renal affections—frequently with the waxy, more rarely with the inflammatory form. It usually proves fatal while the renal malady is yet in its early stage. *Hydrothorax*, acute or chronic, is often seen in dropsical cases. *Pleurisy* occasionally occurs with all the forms of Bright's disease, and may be due to the state of the blood; or, as seems more likely, to increased susceptibility to inflammatory changes, which results from the lowered vitality of the organism. *Dyspnœa* is frequently met with in the inflammatory and cirrhotic forms of the disease, and may be independent of any local lesion, being probably a result of uræmic poisoning. *Œdema glottidis* is apt to occur in inflammatory cases, when even a slight laryngitis has from any cause been brought on.

(ε) Complications affecting the Skin and Subcutaneous Tissues.

Dropsy, in the form of anasarca, is almost constantly present in the early stage, and during exacerbations of the inflammatory form. It can scarcely be said to occur in uncomplicated waxy and cirrhotic cases. *Eczema* is occasionally troublesome in chronic cases. *Erysipelas* is met with now and then, always constituting a serious addition to the other malady.

(ζ) Complications affecting the Urinary Organs.

The chief of these is scrofulous disease of the kidney, and more rarely of the bladder and prostate. They occasionally occur along with the waxy affection.

(η) Complications affecting the Reproductive System.

By far the most important complication is pregnancy, which may coexist with any of the forms of renal disease. Most frequently it is the inflammatory variety that causes danger, and in it dropsy is a prominent symptom, and uræmic convulsions and coma may at any time occur. But in many cases of this kind the term of utero-gestation is completed without the occurrence of uræmia, and often when uræmia does occur the patient comes safely through the ordeal, the delivery being effected, and the nervous symptoms passing off. Cirrhosis may coexist with pregnancy, and a woman may have successive satisfactory confinements during the continuance of this renal disease. It is rarer to find pregnancy in women suffering from waxy disease, but it may occasionally occur.

Sometimes also there may be strumous disease of the uterus, complicating waxy degeneration of the kidney. Strumous or syphilitic disease of the testicle may be similarly associated.

(θ) Complications affecting the Nervous System and Special Senses.

Uræmic blindness may occur, which is sudden and usually temporary, being unaccompanied by any lesion recognisable by the ophthalmoscope. It is generally met with in advanced cirrhotic and inflammatory cases. *Retinitis albuminurica* is a peculiar and characteristic inflammation of the connective tissue of the retina, leading to the formation of white patches and lines, with fatty degeneration. With it are also frequently associated minute hæmorrhages into the substance of the retina. This occurs by far the most frequently in cirrhosis. It is often also seen in the advanced stages of the inflammatory form, and is rarely recovered from except in the case of pregnant women, in whom it seems apt to occur as a passing condition.

Uræmia includes a group of the most striking symptoms of Bright's disease. It may occur at the commencement of the acute inflammatory affection, or in its later stages, or in the chronic forms. The condition is, however, rare in the purely waxy disease, but common in the cirrhotic. There are several types of uræmia, of which the most important are :—(*a*) Sudden acute convulsions, followed by coma and death; (*b*) Gradually advancing torpor, passing at last into coma. The clinical features of these and minor varieties are described, and the hypotheses as to their origin discussed, in the article Uræmia.

Headache is frequently complained of by patients suffering from Bright's disease. *Apoplexy* from hæmorrhage into the substance of the brain is common in the later stages of the inflammatory and cirrhotic diseases. It is due partly to the degenerated state of the vessels, and partly to the increased pressure resulting from cardiac hypertrophy.

(ι) Complications affecting the Locomotory System.

Of these the only ones of importance are *diseases of bones and joints*, which may occur as causal or concomitant complications in waxy cases; and *gouty affections*, which have been already mentioned in connexion with the cirrhotic disease.

Diagnosis.—(*a*) **Of Bright's Disease from other affections.**—From *functional albuminuria* the organic diseases of the kidney are to be distinguished by comparison of the clinical history of the respective conditions. The writer has sought to distinguish four forms of functional albuminuria :—I. *Paroxysmal albuminuria*, a condition often associated with paroxysmal hæmoglobinuria, the discharge of albumen sometimes preceding, sometimes following, and sometimes replacing the hæmoglobin discharge. The attack comes on occasionally, is marked by very distinct albuminuria, and by the presence of numerous tube-casts, and often oxalates, but the symptoms very rapidly again disappear, and are not attended by dropsy. II. *Dietetic albuminuria*, in which the albumen appears only after the ingestion of food, of some particular meal or some special article of diet. III. *Albuminuria from exertion*, in which the discharge of albumen follows muscular effort of a more or less severe kind. In these two varieties (both of which stand related to Pavy's 'cyclical albuminuria' and the 'albuminuria of adolescence') a comparison of the secretion passed at different times of the day and night, enables one to mark the functional off from the organic diseases, for at one time there is no albumen, or almost none; at another it is abundant; and one soon learns to make out in the functional cases the precise conditions which induce its appearance. Other urinary conditions which characterise the functional cases are the normal discharge of urea, the absence of casts, and the occasional occurrence of phosphaturia, of oxalates, of urates or uric acid, of sugar or other chemical abnormalities. Much weight is also to be attached to the absence of the characteristic general features of Bright's disease. IV. *Simple persistent albuminuria*, in which patients continue to discharge albumen with the urine for long periods without giving evidence of organic disease. This is much more difficult to distinguish. The diagnosis depends mainly upon evidence excluding Bright's disease, such as the complete, or almost complete, absence of tube-casts, the discharge of a normal or even excessive proportion of urea, the absence of the complications of Bright's disease, particularly of the various causal, concomitant, and consequent complications which are so generally associated with it. Thus, for example, if a patient has albuminuria for months, but secretes abundance of urea, does not become anæmic, has no increased tension of pulse nor hypertrophy of heart, no tendency to dropsy, or to retinal changes, or any other of the well-known complications, we may conclude that he is suffering from functional disease. But diagnosis and prognosis must always be cautiously expressed in cases of this kind. From *passive congestion of the* *kidneys* due to cardiac disease these maladies are distinguished by the general condition of the patient; the absence of cardiac disease, and of congestion in other organs; and the characters of the urine. In heart-affections the urine is generally scanty, high-coloured, not of low specific gravity. It may contain albumin, and deposits urates, but rarely blood, renal epithelium, or tube-casts. Hyaline casts may be present, but never in any large quantity. The presence of epithelial and fatty casts, or marked diminution of the amount of urea in any case, proves at least the co-existence of actual inflammation of the kidney. From *paroxysmal hæmoglobinuria*, Bright's disease is distinguished by the abrupt commencement and brief duration of this malady; by the marked nervous symptoms, with gastric catarrh, and sometimes slight jaundice; and by the absence of dropsy. In hæmoglobinuria also the condition of the urine is very distinctive; the dark-red colour being due, not to blood-corpuscles, but to granular pigment, the deposit consisting mostly of this material and of tube-casts. *Hæmaturia*, with tendency to suppression of urine, is distinguished from Bright's disease by the small proportion of epithelial tube-casts, and in some cases by the complete absence of casts. There may be a question whether the case is one of hæmaturia or of commencing acute inflammatory Bright's disease; or, again, whether it is one of a chronic affection, cirrhotic or cystic, in which hæmorrhage has come on. The cases in which Bright's disease simulates hæmaturia are generally the sequelæ of scarlatina or diphtheria; and, therefore, even when these diseases have been overlooked, the presence of desquamation or of paralysis may afford a clue; but the peculiar reddish-brown deposit, rich in cells and in epithelial tube-casts, which occurs in Bright's disease, makes the case clearer even when, as often happens, there is no dropsy. Again, when the question is between simple hæmaturia and hæmaturia with cirrhosis or cystic disease, the evidence afforded by the tube-casts is not important, but the hypertrophy of the heart, the thickening of the arteries, the character of the pulse, the albuminuric retinitis, the low specific gravity of the urine and the small amount of urea which it contains, as well as the tendency to hæmorrhage from other sources, afford evidence of the presence of the chronic organic disease.

Slight *pyelitis*, with or without renal calculus or gravel, may simulate Bright's disease; but the history of pain, the presence of mucus and pus-corpuscles in the urine, of oxalate of lime or uric acid, with the full proportion of urea, and the absence of tube-casts, or their presence only in small quantities, indicate the nature of the case.

(β) Of the different forms of Bright's disease from each other.—The discrimination presents in simple cases little or no difficulty. The points to be attended to are the history of the patient; the amount and characters of the urine; the presence or absence of dropsy; and the nature of the complications. The previous occurrence of exanthematic affections, of chronic wasting disease, or of intemperance, gout, or plumbism, would afford some obvious indications. The mode of origin and progress of the malady is very important. Thus a case commencing acutely with dropsy and diminution of urine is inflammatory; one of less acute character, with polyuria, is waxy; and one commencing insidiously, with no marked symptom until perhaps convulsions or dimness of vision appeared, would be an example of cirrhosis. The leading symptoms of the *inflammatory* variety are diminution of urine; an abundance of albumin and of epithelial tube-casts, with diminution of urea; and marked dropsy. Other indications may be gathered from the complications of each form of Bright's disease. It must be remembered that mixed forms frequently occur, and that in these careful inquiry and patient investigation are essential to the establishing of a correct diagnosis. Of the *waxy* kidney, the prominent features are early and persistent polyuria; waxy degeneration of other organs; and absence of dropsy. In the *cirrhotic* form the insidious commencement; the gradual development of vascular and cardiac changes; with in the later stages, in many cases, polyuria, are the most important phenomena.

Prognosis.—The prognosis, though always grave, varies in the different forms of Bright's disease. In the *inflammatory* affection it is least unfavourable, although this affection is the most immediately dangerous. During its first stage we may always hope for complete recovery, especially in cases of post-scarlatinal origin. Of forty-one successive cases treated by the writer in the Royal Infirmary, Edinburgh, twenty-two recovered entirely, while twelve died, and seven passed into the second stage. If this be the proportion in hospital cases, which are generally sent there on account of their severity, and are rarely sent in the earliest stages of the disease, it is obvious that the proportion of recoveries must be much larger in private practice. When the disease reaches the second stage, the prognosis is more grave, complete recovery being rare, and death sometimes taking place from sudden or gradual increase of the symptoms, or from intercurrent affections. But even in this condition complete recovery may be brought about, and in many cases the patient goes on for long periods, presenting few symptoms fitted to attract attention. In the third stage the prognosis is entirely unfavourable, the system becoming steadily more deteriorated, and death occurring, either from the direct effects of the disease, or from complications. Still, even such cases often go for long periods, if placed under favourable hygienic and therapeutic conditions.

In the *cirrhotic* form the prognosis is very unfavourable, but the progress of the disease is so slow that it is often unadvisable to say anything about it to the patient, as the fatal result may be long deferred. It must, however, be kept in view that the disease is commonly far advanced before its existence is made out.

In the *waxy* form the prognosis must almost always be unfavourable, although the malady is never rapidly fatal. On the contrary, its course is always chronic, in some cases extending over five or even ten years. The fatal result is due to complications more frequently than to the disease itself. Recovery probably sometimes takes place, but only when the cause of the degeneration is removed, and the general surroundings of the patient are favourable. It is certain that the liver and spleen may to a large extent recover from waxy disease, and recovery has been witnessed in cases which presented all the symptoms pointing to implication of the kidneys.

Among the symptoms and complications which are fitted to cause special alarm when they occur in connexion with any of the forms of Bright's disease, we must recognise suppression or great diminution of urine, especially if accompanied by nervous phenomena or general dropsy; uræmia, more particularly its chronic form; and acute inflammations and hæmorrhages. Retinitis albuminurica is always a very serious symptom, except when it occurs in pregnant women.

Treatment. — (1) Of the *inflammatory form*. The objects to be kept in view are to arrest the inflammatory action; to remove the inflammatory products from the kidneys; to supply the deficiency induced by the drain upon the system; and to obviate the deleterious effects upon the system generally of the accumulation of effete materials. One remedy or plan of treatment may meet more than one of these indications. The most useful means of subduing the inflammatory action, or at least the congestion which attends it, are local blood-letting by means of leeches or wet cups; dry-cupping; and the application of hot fomentations, poultices, and counter-irritants. Blood-letting is only serviceable in the early stage of the disease, or when severe exacerbations with suppression of urine occur. Poultices or hot fomentations are of use in the same circumstances. Counter-irritation is helpful in the more chronic conditions. Iodine and croton oil inunction are the best fitted for its induction, while cantharides must be avoided on account of its tendency to irritate the kidneys.

The removal of the inflammatory products which block up the uriniferous tubules is of the utmost importance, and is in the great majority of cases best effected by means of diuretics. Water and diluent drinks are the safest, and are sometimes found sufficient. The medicinal diuretics must be non-irritating, and the best of all is digitalis, which may be given safely even when the urine is bloody. It may be administered in the form of infusion, tincture, or made up into a pill. Of the infusion from a drachm to an ounce, of the tincture from five to thirty minims, of the powder from half-a-grain to two grains, should be given three times a day. The infusion or the tincture may be combined with spirit of nitrous ether, with acetate of potassium, or with tincture of perchloride of iron. Its action is often favoured by the addition of squill and carbonate of ammonium. Other diuretics, such as caffeine or strophanthus, occasionally act better than digitalis. Sometimes it happens that diuretics do not suit the case, the urine becoming diminished and more bloody under their use; and in other cases the symptoms become so urgent that death might take place before there would be time for diuretics to act. In either of these conditions relief must be obtained by the bowels or skin. The bowels are best acted upon by means of from twenty grains to a drachm of the compound jalap powder, or one-twentieth to half-a-grain of elaterium. The action of the skin may be excited by the use of acetate of ammonia or antimony; but pilocarpine, hot air, vapour-baths, and the wet pack are the most efficient agents. Throughout the whole course of the disease constipation should be avoided, and the action of the skin encouraged. When the disease has become less acute, and certainly when dropsy persists during the second stage, other diuretics are of the utmost value, particularly the acid tartrate of potassium, the oil of juniper, and the decoction of broom. Iron must be assiduously administered, to make up for the waste of the materials of the blood. Gallic acid, ergot, hydrochlorate of rosamilin, and belladonna have all been praised as tending to diminish the discharge of albumin resulting from a persistent chronic inflammation of the tubules. The treatment of special symptoms and complications will be considered after indicating the general management of the other varieties of Bright's disease.

The diet during the earliest stages should be easily assimilable, and not too rich in nitrogenous elements. Milk is, as a rule, well borne. Some practitioners laud skimmed milk as an unfailing remedy in the disease. It is a good diuretic, and, when it suits the stomach, a good article of diet, but possesses no other therapeutical virtue. In the more chronic stages the food should be of a more nourishing kind, and a moderate allowance of stimulants may be needed.

(2) In the *cirrhotic form* it is probable that no remedy we at present possess can

influence the pathological process, although arsenic and alkaline remedies, and particularly iodide of potassium, enjoy a certain reputation. It is the duty of the skilful physician to ward off or minimise the results of the morbid process. It is obviously of great importance to avoid the causes of the disease. Lead-poisoning should be avoided; the gouty tendency kept in check; and the free use of alcohol forbidden.

(3) In the treatment of the *waxy form*, the most important indication is to seek to remove the cause of the degeneration, if still existing. If there be disease of bone or chronic abscess it must, if possible, be cured; constitutional syphilis must be combated by appropriate remedies. The tincture of perchloride of iron, quinine, nux vomica, and combinations of these in the form of phosphates, are useful. The patient must also have good food, and should lead an easy life.

(4) In the management of the *combined forms* of Bright's disease these plans of treatment must be conjoined according to circumstances, but, on the whole, treatment is much less successful than in the simple cases. In the combined waxy and inflammatory affection, for instance, it is not uncommon for dropsy to persist, although the diuretics bring the urine up to or above the natural standard.

(5) With regard to the special *symptoms* and *complications* of Bright's disease, the gastric catarrh is often benefited by the use of bismuth, soda, and rhubarb; the sickness and vomiting are best relieved by counter-irritation over the stomach, and by giving ice, milk, and hydrocyanic acid internally. These symptoms are, however, often very intractable. Diarrhœa must sometimes be let alone; at other times it must be treated by means of astringents or sedatives, either administered by the mouth or as enema or suppository. Ascites must be treated as a manifestation of dropsy, and occasionally the abdomen requires tapping. Peritonitis must be combated by hot fomentations and opium, but the latter requires great care in its administration. All through the disease in all its forms hæmatic tonics are demanded; iron in some form should be constantly administered. For hæmorrhages the pernitrate of iron, local astringents, ergot and ergotin, gallic acid, or acetate of lead must be tried in various combinations. The best results have followed the use of ergotin in 3- to 5-grain doses injected subcutaneously. The irritating effects sometimes observed after the subcutaneous injection of ergotin may often be obviated by boiling the solution, or by the addition of a minute quantity of salicylic acid. Hydropericardium and pericarditis must be treated in the usual way. In the latter the writer has repeatedly seen much benefit follow the application of leeches, and during the past few years has witnessed a number of recoveries from this complaint. The vascular and cardiac symptoms are often relieved by the use of the nitrites, and particularly of nitroglycerine cautiously administered. Bronchial catarrh must be carefully attended to, by the avoidance of exposure to cold, by the application of counter-irritation externally, and by the internal administration of expectorants. Œdema of the lungs must be treated by counter-irritants, and by remedies fitted to reduce the general dropsy. Pneumonia, phthisis, and pleurisy must be treated on ordinary principles. Hydrothorax may demand paracentesis. General dropsy is one of the most important complications, and should be combated by means of diuretics, purgatives, and diaphoretics; in many cases the introduction of Southey's tubes or puncture of the œdematous parts is demanded. When these methods have been determined upon, precautions must be taken to avoid inflammation. Eczema and erysipelas, when they occur, should be dealt with according to ordinary principles. Headache is relieved in different cases by iron, by hot or cold applications to the head, by quinine, or by inhalation of a few drops of nitrite of amyl. When uræmia occurs in acute inflammatory conditions, or with suppression of urine, dry-cupping or wet-cupping over the renal regions should be tried, along with free purgation and hot-air baths and, especially in puerperal cases, general blood-letting. But, above all, reliance must be placed in the use of pilocarpine. Generally it is best to inject it subcutaneously, and thereby produce diaphoresis. Bromide of potassium should be given in drachm doses, and if convulsions be severe, the patient must be kept under the influence of chloroform. In the more chronic and gradually advancing form of uræmia, counter-irritation at the back of the neck and over the scalp sometimes appears to be useful. But treatment is not so often of advantage in this as in the other form. In the eye-affections, iodide of potassium enjoys some reputation. Hæmorrhagic apoplexy demands no special discussion in this article.

T. Grainger Stewart.

BRINKENAU, in Bavaria.—Chalybeate waters. *See* Mineral Waters.

BROMIDROSIS (*βρῶμος*, a stench; and *ἱδρῶς*, sweat).—A term for fetid perspiration. *See* Perspiration, Disorders of.

BROMISM.—Definition.—Bromism is the term applied to the morbid effects produced by the administration of the salts of bromine under certain circumstances.

Description.—The effect of the salts of bromine, when administered in medicinal doses, is to reduce nervous activity; and thus, with a certain amount of anæsthetic influence, to promote rest and sleep. When such doses have been long continued, or in certain idiosyncrasies, or when excessive doses are administered, results are produced which constitute a state of disease, and to this condition the term 'bromism' is applied. These results are manifested on the brain and spinal cord; on the skin; on the mucous membranes and glandular structures; and on the organs of circulation and respiration.

1. *On the Brain and Spinal Cord.*—When the therapeutic action intended to be obtained from the use of a salt of bromine is exceeded, the quiet or sleep becomes more pronounced, and there is more or less constant somnolence; the memory becomes impaired, words being forgotten or misplaced, whilst written and spoken language is confused, the tongue is tremulous, and speech is difficult. The gait becomes feeble and staggering, with inability to control movement, and somewhat resembles the condition observed in locomotor ataxy. The special senses—sight, hearing, taste, and touch—are impaired. Reflex excitability is diminished. This impairment is especially observed in the fauces, where touching does not as usual cause sickness; indeed it may occasionally be present to such a degree as to lead to difficulty in swallowing. Sexual feelings are diminished or altogether suppressed. The general aspect of a case of well-marked bromism much resembles one of senile imbecility.

2. *On the Skin.*—A very frequent result of the internal use of the bromides is a follicular eruption of the skin, closely resembling acne. It is generally situated on the face, chest, and shoulders. When the use of the drug is persisted in, the acne becomes aggravated, and boils appear. A more rare form of skin-disease similarly caused has been described by Dr. Cholmeley, Mr. Hutchinson, M. Voisin, and others. This disease appears as vesicles, which become aggregated into clusters or patches. They proceed to suppuration, and are soon followed by scabbing, their base being slightly raised, hard, sometimes ulcerated, and surrounded by a red areola. In a later stage the eruption presents the appearance of dusky red stains. It has been observed more especially on the limbs and head. Eruptions having more or less the characters of erythema and of eczema have also been described as following the use of these agents.

3. *On the Mucous Membranes and Glandular Structures.*—Dryness of the mouth and tongue is often experienced in bromism; but in some cases there is said to be an increased flow of saliva. Nausea, flatulence, eructations having a saline taste, heat and fulness at the epigastrium, and occasionally gastric catarrh and diarrhœa, have been observed; it is said that acute enteritis and even a typhoid condition have occurred.

4. *On the Organs of Circulation and Respiration.*—The salts of bromine are said to produce contraction of the capillaries. The skin may present a peculiar dusky hue or pallor, and the extremities are cold. The action of the heart is rendered slower and weaker; and may even cease altogether, under the continued operation of these drugs. The action on the respiratory organs is similar to that upon the heart. It has been observed that bromine—recognised by its peculiar odour in the expired air—is eliminated from the respiratory mucous membrane. Bronchial catarrh occurs, and instances are recorded in which pneumonia is said to have followed and proved fatal.

It must be remembered that, although it has been thought desirable to discuss separately here the effects of the bromides on the several systems, these effects are combined in various degrees. In some cases the affection of the skin is alone noticeable; in others, that of the nervous system; while in a third class there is produced a combination more or less of all the phenomena, constituting what may be called a *cachexia.* In such cases we find loss of flesh and strength, of colour and mental power; paralysis of the muscles; loss of reflex and general sensibility and of the functions of the special senses; complete apathy and general prostration, the countenance having a semi-idiotic expression; coldness of the extremities; and gradual failure of the heart's action.

Pathology.—The condition just described is but the extreme effect of the ordinary physiological action of the salts of bromine. This condition may be due either to idiosyncrasy—that is, to undue susceptibility on the part of the individual—or to the administration of large quantities of the drug, either in medicinal doses for a long period, or in excessive doses administered within a short time. The individual susceptibility may depend upon the want of capability to eliminate the drug; on the general state of health; or on the presence of a disease which resists its action. Under these circumstances, as well as in the presence of certain modifying influences, such as the action of other remedial agents simultaneously administered, it is difficult to fix upon the amount of a bromine salt capable of producing morbid symptoms in any given individual. The writer has seen a nightly dose of ten grains of bromide of potassium, continued for some weeks, produce marked somnolence during the day, and impairment of memory; whilst it has required the enormous doses of 200 or 300 grains a day, which seem to be administered on the Continent, to produce the extreme effects above described. The rapidity with which these effects are produced, constituting the *acute* and *chronic* forms of bromism, will depend on the amount and frequency of the dose, and on the susceptibility of the individual. The effect of a sudden considerable increase in the dose has been observed by the writer in a case which first directed his attention to the subject of bromism in 1872. This case he saw in consultation with Mr. Alfred Burton. Half-drachm doses of bromide of potassium had been taken twice a day for several weeks, when by mistake the quantity of the drug was doubled; then, after three days, symptoms closely resembling senile imbecility were rapidly developed.

Diagnosis.—Recognising the value of the bromides,[1] and the frequency with which they are used, it is extremely important that the peculiar results which they are capable of producing should be borne in mind; for if they are not recognised in time, and if the use of the drugs be persisted in, disastrous effects, which might otherwise be avoided, will follow. Without going into details of diagnosis, it will probably be sufficient to point out the necessity for remembering that the symptoms which have been described above can be produced by the use of bromides; and that when such a combination of symptoms does occur during their use, it is highly probable, in the absence of disease capable of accounting for them, that the symptoms have originated from the operation of these agents.

Treatment.—This consists in stopping the use of the drug, and hastening its elimination by promoting the action of the kidneys and other excreting organs. It is found that arsenic in combination with these salts acts in some measure as a preventive of the eruptions.

The above description refers more especially to the effects of bromide of potassium; but like effects are produced by other salts of bromine, though to what extent by each has not been so clearly ascertained.

Richard Quain.

BRONCHI, Diseases of.—Synon.: Fr. *Maladies des Bronches*; Ger. *Bronchien-Krankheiten*.—The diseases of the bronchi will be discussed in the following order:—**1.** Acute inflammation; 2. Chronic inflammation; 3. Plastic inflammation; 4. Dilatation; 5. Narrowing or obstruction; 6. Cancer.

1. Acute Inflammation—Acute Bronchitis—Acute Bronchial Catarrh.

Definition.—An acute inflammation or congestion, general or partial, of the bronchial tubes.

Ætiology.—The causes of acute bronchitis may be classed as (*a*) *predisposing*, and (*b*) *exciting*.

(*a*) *Predisposing causes.*—Of these age is one of the most important. The disease is indeed confined to no period of life, but is most frequently met with in the young and the old; and in these subjects it assumes its most serious characters. The imperfect development of the infant, and the diminished vitality of the aged, seem to render them especially liable to attacks of bronchitis, and to make the disease exceptionally fatal in them. Sex appears to have no influence as a predisposing cause. The habits of life have an important influence in the causation of bronchitis. The practice of living in heated rooms, especially where gas is largely consumed, and of breathing the vitiated atmosphere produced by the assemblage of large numbers of persons in apartments, is undoubtedly a fertile predisposing, as well as exciting, cause of the complaint; so also is the practice of keeping children too much within doors on the one hand, or, on the other, of exposing them to inclement weather when insufficiently clad. Temperament can scarcely be considered a predisposing cause, but the state of the general health exercises a powerful influence. A weakly constitution, or one weakened by overwork, improper food, &c., predisposes to bronchitis; whilst such affections as Bright's disease, gout, and diseases of the heart, alike favour its occurrence. Again, certain occupations are favourable to the development of bronchitis. Independently of the fact that living or working in heated and confined rooms predisposes to the disease, such occupations as lead to the inhalation of irritating particles, as those of steel, cotton, &c., give rise to it. The climate most favourable to the production of bronchitis is probably that which is at the same time both cold and damp, and where sudden variations of temperature occur. The seasons of the year in which it prevails most are the late autumn, the winter, and the early spring.

(*b*) *Exciting causes.*—Although undoubtedly cold directly applied to the surface of the body is in a large number of cases the exciting cause of bronchial inflammation, still the transition from cold to heat—passing from a cold atmosphere to a heated one—is an important factor of the disease. There can be little doubt that bronchitis is often produced directly by the effects of heated and vitiated air on the bronchial membrane, and on the system at large; and that, in the latter instance, the affection is merely a local manifestation of a general influence. Bronchitis may also be caused by the direct action of irritants contained in the air—as irritant vapours, minute particles of steel, cotton, or ipecacuanha, and the emanations (pollen) from flowering plants. Again, morbid conditions of the blood, the result of specific febrile affections, act as exciting causes of the disease; as do also the poison of syphilis, and the altered condition of the blood produced by gout. Bronchitis, moreover, must be regarded as a constant accompaniment of influenza.

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[1] It is of interest to record here that the use of bromide of potassium in this country dates from May 1857, when its value in the treatment of hysteria was mentioned by Sir Charles Locock at a meeting of the Royal Medical and Chirurgical Society, of which he was then President.

Anatomical Characters.—The mucous membrane is mainly affected in acute bronchitis, but morbid changes may be produced in the deeper structures. The mucous membrane is red—the redness being arborescent, streaked, or mottled, but not usually spread uniformly over a large surface. The injected condition of the membrane does not, as a rule, extend into the finer bronchial tubes, but in some cases where there have been frequent attacks of inflammation, these tubes have a red appearance. The membrane is sometimes thickened and soft, but ulceration is very rare. The tubes are generally found more or less filled with secretion, either frothy mucus, muco-pus, or even actual pus. Sometimes the secretion is very abundant, filling all the tubes. Fibrinous masses are occasionally met with, which may form casts of the tubes. Collapse of portions of lung-substance—lobulettes or whole lobules of the lungs—is not infrequently found, as are also patches of lobular pneumonia. The venous system and the right side of the heart are overloaded, and the blood is dark. In many cases fibrinous deposits are found in the cavities and great vessels of the heart.

In speaking of the pathology of bronchitis, it is necessary to refer to the distribution of the bronchial blood-vessels. The bronchial arteries when they have fairly entered the lungs have no accompanying veins. The so-called bronchial veins are some small vessels which return the blood supplied to the structures about the roots of the lungs. The blood which is supplied to the bronchial tubes, when they have commenced their divisions, passes into radicles of pulmonary veins, and is returned directly to the left side of the heart. The question whether there is a communication between the bronchial arteries and the pulmonary artery, is still *sub judice*. If such communication exist, it is only slight. The blood of the bronchial arteries, after supplying the mucous membrane and other structures of the tubes, passes, either wholly or in a very large part, to the left side of the heart, not having circulated through the aërating portion of the lungs. The circumstances of this anatomical arrangement are most important in a practical point of view. Anything which embarrasses the circulation on the left side of the heart—such as mitral regurgitation—must necessarily cause a very loaded condition of the bronchial vessels; and all physicians are familiar with the form of bronchitis which is so common in these cardiac affections. The congested mucous membrane, and the profuse bronchial secretion, are the result of the direct impediment to its circulation which the blood meets with, from passing at once into vessels which go straight to the left side of the heart. The relief often afforded in this form of bronchitis by the exhibition of digitalis, is explained by the circumstance above referred to.

Symptoms.—The symptoms of acute bronchitis vary according as the larger or smaller tubes are affected. The disease attacks first, the larger and medium-sized tubes; and, secondly, the smaller ones. To this latter form of the affection the name of *capillary bronchitis* has been given.

1. Acute bronchitis of the *larger tubes*. The attack is usually ushered in by symptoms of catarrh—sneezing, lachrymation, a sense of fulness about the nose and eyes, with frontal headache; the throat becomes dry and sore, and then increased secretion sets in; the follicles at the back of the pharynx become enlarged; the upper part of the larynx is often involved, there being slight hoarseness; and the affection gradually creeps down into the bronchial tubes. The disease is not ushered in by decided rigors, but chills and sometimes shiverings are experienced; the pulse is not much affected, but its frequency is increased in some cases; there is a general sense of malaise, as well as a want of energy. When the disease has set in fully certain local symptoms are found. More or less pain is felt behind and above the sternum; the sensation is increased by a deep inspiration; the pain shoots at times over the chest in the direction of the larger bronchial tubes; and there is a tickling or unpleasant irritation felt behind the sternum, which gives rise to a cough. Dyspnœa is not a marked feature of this form of bronchitis; it exists, however, sometimes; and in the most severe cases a sense of oppression, weight, and tightness about the chest is experienced. Cough is one of the earliest and most prominent symptoms; it is at first dry, and there is usually at this period some hoarseness. The cough is paroxysmal, and often very violent; it becomes attended with expectoration as the disease progresses. This varies at different stages of the affection; at first watery and frothy, and almost transparent, it becomes, as the disease progresses, more consistent, viscid, and opaque, passing through the stages of mucus to muco-pus and pus; it is sometimes distinctly nummulated. Small streaks of blood are occasionally seen mixed with the sputa. Examined under the microscope the sputa are found in the early stages of the disease to contain epithelial cells from the mucous membrane; and, later, many of the so-called exudation-corpuscles, molecular and granular matter, pus-cells, and occasionally blood-discs.

In the milder cases of this form of bronchitis there is but little general disturbance; and even in the more severe cases the febrile reaction is not usually very great. The pulse rises a little, but does not become very frequent; the temperature rarely becomes high; there is in many cases but little interference with the appetite. A general feeling of depression, which in some cases is very marked, is usually experienced.

2. Acute bronchitis of the *smaller tubes—Capillary bronchitis.* This is a very formidable disease. It attacks the finer bronchial tubes, and probably extends to their smallest ramifications. Its symptoms are very grave. Some of the worst cases of capillary bronchitis are met with in connexion with emphysema of the lungs. It may be an extension of inflammation from the larger tubes; or the capillary tubes may be attacked simultaneously with the larger ones, or alone. The early symptoms are more severe than those of ordinary bronchitis, and rigors are more common. Dyspnœa is marked; it may vary from mere rapid respiration to constant or paroxysmal orthopnœa. The respirations may rise to fifty in a minute. Cough is almost continuous, at times becoming very violent and most distressing. Expectoration is attended with difficulty. The sputa soon become very abundant, and rapidly assume a purulent character; or they are very viscid and ropy.

The general symptoms are very severe. The fever is high—the temperature reaching to 103° Fahr. and upwards; and the pulse is frequent, rising to 120 or 140. The temperature rarely attains the height which characterises acute tuberculosis or pneumonia. There are often profuse perspirations, and in some cases excessive debility is felt. If the disease progresses unfavourably, symptoms of very imperfect aëration of the blood come on. The face becomes turgid and bloated, the lips and ears get livid, the veins are distended, the temperature falls, cold clammy perspirations break out, the pulse becomes very small and rapid, delirium supervenes, the respiration is shallow and catching, and the patient dies of asphyxia, and from the presence of fibrinous clots in the heart and great blood-vessels.

Physical Signs.—The physical signs of both forms of acute bronchitis may be referred to together. Inspection reveals little of practical value in simple bronchitis. The chest-form is not altered. In severe cases the abdominal movements are in excess. The costal movements are frequently those of elevation rather than expansion. In extreme cases the lower end of the sternum and the connected cartilages sink with inspiration; while the expiration-movements are slow, laboured, and inefficient. If the hand is applied to the chest, rhonchal fremitus may be often felt, sometimes over a large area. The percussion-sound may be somewhat exaggerated from over-distension of the lungs, especially in children; not appreciably altered; or deficient in resonance, owing to the accumulation of secretion at the bases of the lungs, to œdema or congestion (as in typhoid fever), or to pulmonary collapse. In young children a sound resembling the cracked-pot sound may be occasionally produced, variable in site. The sounds heard in auscultation vary according to the stage of the disease. The breath-sounds are loud when the tubes are free; when the latter are plugged by secretion, they often become feeble or even totally suppressed, from closure of a tube leading to a portion of the lung. The adventitious sounds of bronchitis include the various rhonchi, dry or moist: the dry rhonchi are heard in the early stages of the disease for the most part, but when once secretion has set in, the moist rhonchi or râles are more or less extensively heard, depending for their character on the size of the tubes which are the seat of inflammation. Thus they are called *mucous* when produced in the large tubes, *sub-mucous* and *sub-crepitant* when produced in the finer ones; the latter term being used to characterise the râles of capillary bronchitis. When the large bronchial tubes are filled with a secretion which is not viscid, the sounds may have a rattling character. The various rhonchi may be heard over different parts of the lungs at the same time, according to the seat and stage of the bronchitis. In capillary bronchitis sub-crepitant râles, accompanying inspiration and expiration, are abundantly heard towards the bases of both lungs especially. As a rule there is no displacement of organs in bronchitis, but the diaphragm is sometimes depressed from great distension of the lungs, and the heart is occasionally displaced towards the right.

Diagnosis.—The diagnosis of acute bronchitis, except in a few instances, presents no great difficulty. In the early stages of whooping-cough it is impossible to decide whether the case is one of simple bronchitis or not, but subsequently the paroxysmal character of the cough settles the point. In some cases of bronchitis occurring in children the breathing may resemble that of croup; but here the presence of catarrh, the wheezing nature of the respiration, the absence of much fever, the characters of the sputa—obtained by wiping the back of the tongue—and their freedom from membranous shreds, and the physical examination of the chest indicating the presence of rhonchi, will be sufficient to establish a diagnosis. From laryngitis the discrimination is not difficult.

Pneumonia may generally be easily diagnosed from capillary bronchitis, with which form it can perhaps be alone confounded. Capillary bronchitis is not ushered in, as pneumonia usually is, by a well-marked and prolonged rigor; the general febrile disturbance is less, and the temperature not so high; moreover the absence of dulness on percussion, and of increased vocal resonance and fremitus will aid in the differentiation. From lobular pneumonia in children the diagnosis is not always easy. In this disease there is often no dulness to be perceived on percussion; whilst, on the other hand, dulness may exist in bronchitis from pulmonary collapse.

The diagnosis of capillary bronchitis from acute phthisis often presents difficulties. The main points to be relied on, independently of the family history, which may aid, are that in capillary bronchitis the fever is less and the temperature lower; signs of asphyxia soon come on; and there is free expectoration of muco-purulent matter, from which the tubercle-bacilli are absent. In one form of acute phthisis there is evidence of pneumonic consolidation, followed by signs of the formation of cavities. In the miliary tubercular form there are in many cases scarcely any physical signs except râles, most marked at the apices of the lungs. Here, however, the diagnosis may be aided by the examination of the sputa under the microscope, which may reveal the presence of tubercle-bacilli.

Prognosis, Duration, Terminations, and Mortality.—The prognosis in an ordinary case of bronchitis is favourable, but when the disease occurs in the very young or the aged the prognosis should always be guarded. In the milder forms the affection may last only a few days, or two or three weeks. Severe cases are more protracted. The disease may terminate in perfect recovery, in death, or by passing into the chronic form. It may be the starting-point of emphysema of the lungs, or of certain forms of phthisis. The mortality is much influenced: (1) by age, being greatest in the very young and the very old; (2) by the previous state of health, which, if lowered by any circumstances, will render recovery more doubtful; (3) by the extent of the inflammation, especially when the disease is of the capillary form; (4) by the existence or non-existence of any organic disease of the heart, lungs, or kidneys; (5) by the disease being epidemic in connexion with influenza or otherwise; and, lastly, by the time the case has come under treatment, whether early or late.

Treatment.—In the treatment of bronchitis regard must be had to the constitutional condition of the patient. Care must be taken to ascertain whether the disease is secondary to some organic affection, or the result of mechanical irritation, or of the presence of gout or rheumatism in the system, or of influenza; or whether it arises idiopathically. The treatment of the disease as a primary affection will be considered first.

In an ordinary case of acute bronchitis it is very desirable to keep the patient confined to his room, and, if the case is at all severe, to his bed. The temperature of the apartment should be maintained at from 60° to 65° Fahr. A higher temperature than this is generally not favourable to the progress of the case. In the early stages of the attack it is well to allow the air of the room to be more or less saturated with steam. A free action of the skin should be promoted; and for this purpose warm drinks, with or without some form of alcohol or some diaphoretic medicine, may be given; or a hot-air bath may be used in bed. Great relief is often experienced from the application of a large mustard or mustard and linseed-meal poultice to the chest; and it is well, if mustard is applied first, to apply immediately afterwards a large hot linseed-meal poultice, to be renewed every few hours. This constant application of warmth and moisture to the chest is often productive of very great relief to the symptoms.

Cases of acute bronchitis do not require venesection, nor is the application of leeches often, even if ever, called for. Severe counter-irritation is moreover to be prohibited. It is generally desirable to act on the bowels, and a mercurial, followed by a saline purgative, will often be of great service. In the old and debilitated, as also in the young, all lowering treatment must, however, be avoided. In the early stages of the affection, before secretion has commenced, and when the mucous membrane is dry and the cough hard, diaphoretics with ipecacuanha may often be given with advantage; but as soon as secretion is fairly established, carbonate of ammonium, spirit of chloroform, ether, cascarilla, senega, or such-like drugs should be administered. Indeed in almost every stage of bronchitis carbonate of ammonium is one of the most valuable remedies we possess. Care should be exercised, especially with the aged, that nothing should be given which will so nauseate as to prevent food being taken. In the exhibition of medicines to alleviate the cough, regard must be had to the condition of the patient and the stage of the disease. Opium in all its forms should be given with caution, especially in the young and old. It no doubt often succeeds in checking cough, but in doing so it also checks expectoration, and causes an accumulation in the bronchial tubes, which sometimes becomes very dangerous to life. Chloral hydrate in small doses is often of great use for relieving cough, and it may be combined with oxymel of squill. It has also a good effect in allaying spasm of the tubes, if this exist. In some cases of bronchitis the question of procuring sleep becomes an important one. Opium in its various forms is generally inadmissible, in consequence of its tendency to increase the condition of asphyxia; but chloral hydrate may be given with safety, and the recovery of a patient may sometimes be dated from the sleep which this agent procures.

In reference to the exhibition of alcoholic stimulants, except in the early stages, and in certain cases dependent on a gouty or rheumatic condition, they should usually be given in smaller or larger quantities. They increase expectorating power, and ward off the tendency to asphyxia. In the old they are especially called for, and, together with carbonate of ammonium, should form the main therapeutic agents to be relied on. In the treatment of capillary bronchitis, ammonia and alcoholic stimulants should be exhibited from the commencement, and the quantity must depend on the symptoms of each case. There is one source of danger in capillary bronchitis which should always be borne in mind, viz. the formation of fibrinous clots in the heart and great blood-vessels. These deposits become the proximate cause of death in many cases, and they are especially liable to form when there is emphysema of the lungs. Their presence may often be diagnosed during life from the respiration becoming very rapid, shallow, and laboured; from the pulse being quick, weak, and small, although the heart may at the same time be felt beating vigorously; from the voice becoming feeble, and the mental faculties seriously impaired. After death a large portion of the cavities of the heart may be found occupied by these deposits, the calibre of the pulmonary artery and the aorta being also materially diminished by them.

In many cases of bronchitis, when the acute symptoms have passed off but the secretion continues profuse, as well as in those cases called bronchorrhœa, the exhibition of iron is often of great service. It seems to give tone to the relaxed capillaries of the mucous membrane, and to diminish the secretion. It may be given in combination with carbonate of ammonium, in the form of the ammonio-citrate; or the tincture of the perchloride with ether or spirit of chloroform may be employed, or the ethereal tincture of the acetate (Ph. Ger.), which is a very valuable preparation in some cases.

Inhalations are useful for allaying cough in the earlier stages of the affection, or for the relief of spasm. In some cases of severe bronchitis where asphyxia has been threatened, recovery has followed the exhibition of large doses—half an ounce—of oil of turpentine. In this dose, however, it sometimes produces alarming symptoms, and it is perhaps better to exhibit it in smaller quantities tentatively. An emetic may be serviceable, especially in children, if the tubes are much loaded. Children suffering from severe attacks of bronchitis should not be allowed to sleep long, for fear of dangerous accumulation in the tubes, and care should be taken that the secretions do not collect about the back of the mouth.

Patients should not be kept on a low diet even at the beginning of an attack, and as the disease progresses the quantity of food allowed may be increased according to the appetite. In the treatment of gouty bronchitis, or bronchitis associated with a tendency to the formation of uric acid in the system, colchicum and the alkalis must be given, and the general measures used which are applicable to the constitutional condition. If bronchitis depend on a gouty state, it will not yield to the ordinary treatment, but when its cause is recognised and the appropriate remedies are administered, the symptoms usually soon begin to improve.

In the cases of bronchitis which are connected with heart disease, and especially with mitral regurgitation, digitalis is often of great value. By steadying the action of the heart it relieves the overloaded pulmonary veins, and thus directly diminishes the congestion of the mucous membrane, as mentioned in the paragraph relating to the pathology of the disease.

It is impossible in the scope of this article to refer specially to the treatment of bronchitic attacks arising from the various kinds of mechanical irritation. There is, however, one form of bronchitis which may be mentioned, viz. that connected with hay-fever, arising either from the inhalation of pollen, or caused by some peculiar atmospheric influence acting on a peculiar nervous system. It is very difficult of cure. In the writer's experience no remedies seem to have any particular influence over it, and it is usually only to be relieved by removing the patient from the exciting cause of the affection. In the treatment of bronchitis depending on constitutional syphilis, the appropriate measures for that affection must be resorted to.

2. Chronic Inflammation — Chronic Bronchitis — Chronic Bronchial Catarrh.

Definition.—A chronic inflammation or congestion, more or less extensive, of the bronchial tubes.

Ætiology.—Chronic bronchitis very frequently results from repeated attacks of the acute disease, but it may be chronic from the beginning. Emphysema of the lungs, dilated bronchi, and phthisis are causes of the complaint; as are also various forms of heart-disease, and some blood-affections, such as gout. The inhalation of irritating particles gives rise to chronic bronchitis; and it is also met with in connexion with chronic alcoholism. It is most common amongst the old.

Anatomical Characters.—The bronchial mucous membrane is discoloured, being of a dull-red tint, greyish, or brownish. The discoloration is usually partial, but sometimes general. There is swelling and increased firmness of the mucous membrane, and the sub-mucous tissue in old-standing cases becomes infiltrated and indurated. The fibrous and muscular tissues are hypertrophied; the cartilages in the larger tubes are sometimes calcareous; and there is generally more or less emphysema of the lungs.

Symptoms.—The symptoms of chronic bronchitis vary greatly in different cases.

They resemble in kind those of the acute affection. There is cough, expectoration, pain, soreness or uneasiness behind the sternum, with more or less dyspnœa. The constitutional symptoms may be very slight, scarcely any effect on the general health being apparent; or they may be very severe. Three forms of chronic bronchitis are recognised clinically:—1. That which includes the ordinary cases of the disease, varying much in severity; 2. That characterised by excessive secretion — *bronchorrhœa*; 3. That form which is called *dry catarrh.*

1. In the first form of chronic bronchitis the cough is at first slight, perhaps only occurring during the winter, being altogether absent in the summer. After a time the attacks become more frequent, and at last the patient is never free from the affection, which is aggravated at times. The cough in such cases is more or less severe, but usually most so in the morning. It is often paroxysmal, and sometimes very violent. The expectoration, in some cases being scanty, viscid, and difficult to discharge, is in others, especially old-standing cases, copious and easy. The sputa vary much both in appearance and quantity. They may be yellowish-white, muco-purulent matter, or more decidedly purulent, of a greenish-yellow or bright or dark green colour; they are but little aërated, sometimes not at all, so that they sink in water; at times they are nummulated and quite opaque. In some cases the expectoration is fœtid, constituting the form of the disease denominated 'fœtid bronchitis,' the odour resulting either from sloughs of minute portions of the mucous membrane, or from chemical changes taking place in the sputa. Occasionally streaks of blood are met with. Microscopically the sputa are found to consist of epithelium, pus-cells, and granular matter, with at times blood-corpuscles.

The constitution does not suffer much in mild attacks, but when chronic bronchitis is permanent and general, the system at large sympathises more or less severely: the appetite fails, sleep is disturbed by the cough, emaciation sets in and sometimes becomes marked, but it does not proceed beyond a certain point, unlike that of phthisis, which is usually progressive. In all cases of chronic bronchitis there is great risk of an acute attack coming on, especially amongst the aged. These attacks are very dangerous, in consequence of the rapid extension of the disease throughout the lungs, and its asphyxiating character.

2. The second class of cases is characterised by excessive secretion from the bronchial tubes—*bronchorrhœa.* This form is often met with in the old and feeble, and especially in cases of valvular disease of the heart. The cough is paroxysmal, and attended with the expectoration of a large quantity of thin watery glairy fluid, or of thick ropy gluey matter, like white of egg. The quantity expectorated is sometimes very large. This form of bronchitis may cause death somewhat suddenly by asphyxia. During the paroxysms of cough there is dyspnœa, but at other times it is absent, except when heart-disease exists. The constitution suffers little, and the flux seems sometimes to be beneficial in cases of obstructive cardiac disease.

3. The third variety, or *catarrhe sec*, is characterised by very troublesome cough, oppression of breathing, tightness of the chest, and sometimes severe dyspnœa. Expectoration is either absent or very scanty, the sputa consisting of small masses of tough, viscid, semi-transparent mucus. There is usually no febrile disturbance. The disease is met with in gouty people, and is often associated with emphysema of the lungs. Pathologically it seems to consist in a congested condition of the bronchial tubes.

Physical Signs.—Inspection reveals nothing abnormal in the form or size of the chest, unless emphysema of the lungs is present. The expansion in long-standing cases is usually deficient; the chest being raised more than in health. Expiration is often prolonged. Rhonchal fremitus may be felt more or less, depending on the state of the bronchial tubes. There is often increased resonance, from the presence of emphysema. The breath-sounds are more or less changed: they may be harsh and loud, and the expiration is prolonged in cases that have existed for a considerable period. The rhonchi vary: they are dry, coarse, moist, or bubbling according to the condition and contents of the tubes. Vocal resonance varies: it may be bronchophonic, normal, or deficient.

Diagnosis.—There is usually but little difficulty in the diagnosis of chronic bronchitis. The affection is most likely to be confounded with phthisis, but the character and degree of the wasting, and the absence of increased temperature, of hæmoptysis, of tubercle-bacilli from the sputa, and of the physical signs of consolidation, will generally enable the practitioner to decide in favour of the less serious disease. The main difficulty lies in the diagnosis of cases where the bronchi are dilated; this will be referred to hereafter.

Prognosis. — Although in itself not a dangerous malady, chronic bronchitis becomes so in consequence of the liability which exists to the occurrence of acute symptoms; when once established in middle or advanced age it is almost incurable. The complaint is further serious from its tendency to produce emphysema and dilatation of the bronchi. *Per se* it can scarcely ever be said to kill.

Treatment.—No case of chronic bronchitis can be successfully treated without due regard to the constitutional condition of the patient. In some cases it is impossible to cure the disease, and all efforts should be directed towards preventing its extension; alleviating the symptoms to which it gives rise; and warding off acute attacks. Attention must be especially paid to the state of the heart and kidneys; the duration of the affection; the age of the patient; the characters of the expectoration; the state of the lungs, as to the existence of emphysema or other morbid conditions; and the presence of gout or rheumatism. Speaking generally, chronic bronchitis must be treated by the use of a generous diet, with more or less stimulants; by the exhibition of expectorants and tonics; and by the avoidance of all depressing measures. The function of the liver must be looked to; and the administration of a few doses of blue pill with a saline aperient often gives great relief, and alters the character of the bronchial secretion. If gout, or a tendency to the formation of uric acid, is present, colchicum with alkalis and other remedies for gout, such as a course of Friedrichshall or Hunyadi or Carlsbad waters, will prove of great service. If cardiac disease exist, whether in the form of valvular incompetence, or of weak, flabby, or dilated heart, digitalis combined with iron frequently produces marked benefit.

In the treatment of ordinary cases of chronic bronchitis, not dependent on any organic disease or constitutional condition, the patient's general health has to be looked to. The affection has a tendency to lower the health and to diminish strength, and therefore the various tonics may often be given with great benefit. Of these the most useful are quinine, the preparations of iron, and those of zinc. Cod-liver oil is also very valuable in some cases where there is much wasting. The cases of bronchitis marked by excessive secretion are generally best treated by tonics; whilst those where the secretion is slight—cases of 'dry catarrh'—being often associated with a gouty condition of the system, are more amenable to the use of colchicum, the alkalis, iodide of potassium, and mineral waters.

In what may be called the symptomatic treatment of the affection, the various expectorants are useful—carbonate of ammonium, ipecacuanha, squill, cascarilla, senega, chloroform, &c., and these may often be beneficially combined with some form of tonic. In many cases of chronic bronchitis the expectorating power is diminished, and stimulating expectorants are of great service. Much caution must be exercised in the administration of opiates and other narcotics or sedatives. When, however, the mucous membrane is very irritable, and when there is but little secretion, with a troublesome cough, these remedies are indicated. Opium is of great value, and chloral hydrate is also very useful, as well as, in some cases, henbane and hydrocyanic acid, or, whenever spasm is present, stramonium, lobelia, the ethers, and cannabis indica. Inhalations are sometimes very beneficial, as of the vapour of warm water, iodine, creasote, and other substances. The inhalation of creasote is especially valuable if the expectoration is fœtid.

Counter-irritation is one of the most important means we possess of relieving chronic bronchitis. The irritation should not be excessive, but should be long-continued. The application of iodine over a large surface of the chest, so as to keep up a constant slight inflammation of the skin, is perhaps the best that can be used; but other irritants may be tried, such as sinapisms, or the various stimulating liniments.

The general management of the patient is most important. A mild climate should, if possible, be chosen in the winter. The patient should live as far as possible in an atmosphere which is mild and dry. Although some cases are benefited by a moist and warm atmosphere, the majority of cases of chronic bronchitis do better in a drier one. The skin must be carefully looked to, its action should bo well maintained, and warm clothing always worn. A moderate amount of some alcoholic stimulant is generally desirable; and the food should be nutritious and of easy digestion. Relief will often be found from wearing a respirator.

3. **Plastic Bronchitis.**—This is a rare form of disease, and of its particular causes nothing is known. It is perhaps connected with some peculiar diathesis. The late Sir John Rose Cormack suggested that it may be a variety of diphtheria. It may occur in either sex, and at any period of life, but is most frequent in those who are of a strumous or phthisical constitution. It has been known, however, to attack persons of apparently healthy frame, and in the enjoyment of robust health.

Anatomical Characters.—Plastic bronchitis is anatomically characterised by the formation of concretions in the bronchial tubes. These concretions consist of fibrinous exudation from the mucous membrane; they form casts of the tubes, and are expectorated. These casts are either solid or hollow, and on examination are always found to consist of concentric laminæ. They are, for the most part, poured out into the finer bronchial tubes, sometimes, however, into the larger ones, but never into the trachea. The casts are of a whitish colour, but they are often stained with blood. Microscopically they consist of an amorphous or fibrillar material, with exudation-corpuscles, granular matter, and oil-globules.

Symptoms.—This disease is essentially chronic, but it has been met with as an acute affection in children. At the times when the casts of the tubes are expelled, exacerbations occur, the patient being attacked with pain and a sense of constriction across the chest, dyspnœa, and an irritating cough. After a time, varying from some hours to a few days, the dyspnœa becomes very urgent, and the cough very severe; then, after a paroxysm of coughing, it is found that the patient has expectorated some solid material, either with or without blood, usually intermixed with ordinary bronchitic sputa. The dyspnœa and cough now subside, to recur after an interval of a few hours or longer. This disease may last for weeks, months, or even years, marked from time to time by severe accessions, and relieved by the expulsion of further concretions. The matter expelled is often in small masses, but at times casts of bronchial tubes with several ramifications are expectorated. The disease may recur at intervals for many years; the general health in such cases does not seem to suffer, the breathing during the intervals being unaffected. There is, in some instances, an absence of febrile symptoms during the attack, whilst in others the fever is more marked. With the general symptoms are combined the *physical signs*. These are somewhat peculiar. The bronchial tubes being obstructed, portions of lung are deprived of air; the breath-sounds are therefore faint or absent. There may be dulness more or less complete on percussion, from collapse of the lung-substance, or, as occurs in some cases, from localised pneumonia. Asphyxia may be threatened if a large tube is blocked up.

DIAGNOSIS.—The diagnosis of this affection turns on the peculiarity of the expectorated matters. Doubtless the disease may be mistaken for ordinary bronchitis or pneumonia; but when once the fibrinous casts of the tubes are observed in the sputa, the nature of the case becomes clear.

PROGNOSIS, DURATION, TERMINATIONS, AND MORTALITY.—The prognosis, if the disease is uncomplicated, is favourable; but there is a great liability to recurrence. The complaint may last for many years, and may terminate in complete recovery. A fatal result generally depends on the presence of some other organic disease, such as phthisis or pneumonia.

TREATMENT.—But little can be advanced as to the value of any special treatment for this affection. Iodide of potassium is said to have been employed with success. The chief object should be to maintain the general health by hygienic measures, and the exhibition of tonics, such as iron, quinine, and cod-liver oil, especially if there be any tubercular taint. During the exacerbations the administration of ammonia and the use of inhalations should be resorted to, and the general principles on which ordinary bronchitis is treated should be carried out.

4. **Dilatation—Bronchiectasis.**—This is a rare disease, which arises as a secondary affection. It is often associated with serious pulmonary mischief, and is at times difficult of diagnosis. There are two forms of bronchiectasis, namely, *general or uniform dilatation*; and *saccular or ampullary dilatation*.

(1) The *general* or uniform bronchiectasis consists in a cylindrical dilatation of one or more of the tubes throughout a considerable portion of their extent. The tubes are evenly widened for the most part, and the dilatations end abruptly.

(2) The *saccular* form of bronchiectasis consists of a globular dilatation of a tube at one point, or at several points. The dilatations vary in size, being from half an inch to an inch or more in diameter. On the tracheal side they usually communicate with a slightly enlarged bronchial tube, whilst on the peripheral side the continuity of the tube is almost or entirely lost from narrowing or actual obliteration. Sometimes the cavities communicate with one another.

The two forms of bronchiectasis often coexist.

The walls of the dilatations undergo changes in the course of the disease. The mucous membrane becomes granular, swollen, and congested; while at a later stage it presents a velvety or villous appearance, and in some cases there is even ulceration with superficial necrosis. The muscular and elastic coats become atrophied, and, coincidently with this, dilatation increases. At times the wasting of these coats is partial; some portion of the walls retaining their natural volume, and forming bands or ridges elevated above the surrounding membrane. The dilated tubes occasionally present an appearance of hypertrophy; the walls are thickened, but the thickening depends on changes which have taken place in the mucous membrane. The cartilages resist the destructive metamorphoses longer than the other structures, but they sometimes partake of them. The contents of the tubes may be either muco-pus, or pus; and casts of the minute bronchi are met with. At times the contents are very fœtid. Crystals of margarin are occasionally found, and sometimes fragments of pulmonary tissue. It is said that the contents may become calcareous.

Dilatation of the bronchi may be unattended with any change in the surrounding lung-tissue, but, generally speaking, condensation of the latter takes place, as the result either of pressure or of chronic pneumonia. In some instances the tissue forms an abscess, in the centre of which the walls of the bronchus are found, whilst in others the walls of the bronchi and the surrounding tissue are destroyed by gangrenous inflammation. It is generally not difficult to distinguish between a phthisical cavity and a dilated bronchus. The latter is not characterised by the broken irregular surface which usually exists in the former; its shape is generally more regular; and it is usually continuous with bronchial tubes. The surrounding lung-tissue has no tubercular infiltration.

The *mechanism* of bronchiectasis has occupied much attention. It is probable that the elastic and muscular fibres lose their elasticity and contractility as the result of chronic inflammation, and thus yield to the distending influence of coughing. When once a dilatation is produced, accumulation of the secretions takes place, which tends further to increase the dilatation.

Symptoms.—The symptoms of bronchiectasis are those of chronic bronchitis aggravated in some important respects. The cough is frequent and paroxysmal. The expectoration is very abundant, very purulent, and, when the disease has lasted some time, very fœtid. The breath also becomes fœtid. Hæmoptysis is occasionally met with, even to a considerable extent. There is more wasting than in ordinary bronchitis, and the blood is more imperfectly aërated. Night-sweats are not uncommon. In fact, the general symptoms approach those of phthisis. The digestive functions are usually not much impaired.

Physical Signs.—The movement of expansion is diminished in bronchiectasis, while that of expiration is prolonged. Over the affected portions of the lung there may be slight retraction. Vocal fremitus is increased, and rhonchal fremitus is sometimes well marked. The percussion note is altered. If a dilated tube is surrounded by condensed lung-tissue, or is full of secretion, there is dulness on percussion; but if it is situated near the surface and empty, some degree of tubular resonance may exist. Cracked-pot sound may be, at times, elicited. The respiratory sounds are harsh, or loudly bronchial with a more or less blowing character, and they may be distinctly cavernous. Vocal resonance is often greatly increased. The pulse becomes rapid in the later stages. The temperature rarely if ever reaches the height that it does in phthisis with cavities, and the daily oscillations are not so marked.

Diagnosis.—The main difficulty as regards diagnosis is in the differentiation of certain cases of phthisis with cavities from bronchiectasis with large globular dilatations. The points to be relied on are that in the latter disease the morbid physical signs are usually met with at the middle and lower parts of the lungs, whilst in ordinary phthisis they are found at the apex; that the temperature differs in the two affections as mentioned above; that emaciation and night-sweats are not so marked in bronchiectasis; and that, if cases are watched, there is usually observed a progressive advance of symptoms in phthisis, whilst in bronchiectasis the symptoms may remain stationary. In phthisis signs of consolidation precede those of cavities, whilst they follow them in bronchiectasis, and in the latter disease tubercle-bacilli are absent from the sputa. Bronchial dilatations and tuberculous cavities have been found in the same lung. The fœtor of the breath and sputa in bronchiectasis may cause a suspicion that gangrene of the lung is present; but the general symptoms will usually enable the practitioner to differentiate between the two affections.

Prognosis.—Bronchial dilatation is probably never cured. It may last for years.

Treatment.—The treatment of bronchiectasis must be that of chronic bronchitis with the use of such measures as are applicable to wasting diseases in general. The fœtor of the breath is best relieved by the inhalation of creasote, or some other antiseptic. The disease has, in some cases, been treated successfully by incision and drainage.

5. **Narrowing or Obstruction.**—Narrowing or obstruction of the bronchial tubes is by no means uncommon, and may depend on intrinsic or extrinsic causes. Complete obliteration of a tube is sometimes found in connexion with bronchiectasis, immediately beyond a globular dilatation.

Ætiology.—The *intrinsic* causes of obstruction are a thickening of the mucous membrane resulting from bronchitis; the retention of viscid secretions; the exudation of plastic material into the interior of the tubes; and the deposition therein of tubercle or cancer.

Amongst the principal *extrinsic* causes are the pressure of adjacent tuberculous or cancerous deposits; the contraction of plastic matter exuded into the tissues surrounding the tubes; solid formations in the pleura; enlarged bronchial glands; and aneurysmal and other thoracic tumours.

Obstruction is most frequently met with in the smaller tubes, but the pressure of thoracic tumours not infrequently causes obstruction, or even obliteration of a main bronchus, which occasionally—as in the case of aneurysms—becomes perforated.

Symptoms.—If a large bronchial tube become suddenly and greatly obstructed, dyspnœa of an urgent character sets in, and death from asphyxia may speedily result, unless the obstruction be removed. When the obstruction is on a smaller scale, being confined to the smaller tubes, or when a large tube suffers only from slow, gradually increasing obstruction, the symptoms are by no means urgent for a time, and slight dyspnœa, sometimes accompanied by stridor, is the most marked feature.

Physical Signs.—Complete obstruction of a bronchial tube invariably leads to collapse of the portions of the lung to which the tube is distributed, and thus an entire lung may collapse if its main bronchus be obliterated. Where partial collapse is produced, emphysema of the neighbouring lung-tissue commonly follows, and if one lung become collapsed, the opposite lung becomes enlarged and emphysematous. The existence of collapsed lung gives rise to dulness on percussion over the affected part, unless this be situated away from the chest-walls, or masked by the presence of emphysema. Further, obstruction of the bronchi causes a weakness or deficiency of the respiratory sounds, with a prolonged expiratory murmur, attended at times with sonorous and sibilant rhonchi. Over the collapsed portion of the lung, or over portions of the lung supplied by a tube which has become completely obstructed, the breath-sounds are absent. Deficiency or absence of vocal vibration is another physical sign of obstructed bronchial tubes.

Treatment.—The treatment of obstruction of the bronchi must depend on the nature of its cause. The chief interest of the affection arises from the means of diagnosis of thoracic tumours which it may afford.

6. Cancer. — Cancer of the bronchial tubes occurring independently of cancer in the lungs, or mediastina, is probably never seen; but cancerous matter has been found in the tubes: (1) in cases where the lungs have been infiltrated with a similar deposit; (2) where a cancerous tumour connected with the root of a lung has perforated a tube; and (3) in some cases of cancerous disease of the lung, a tumour of a similar nature being found connected with the mucous membrane of a tube. (4) Cancerous matter has also been found *in transitu* in a tube, having been detached from a cancerous mass.

A. T. H. Waters.

BRONCHIAL GLANDS, Diseases of.

— Synon.: Fr. *Adénopathie Trachéobronchique;* Ger. *Krankheiten der Bronchialdrüsen.*

Definition.—Disease of those lymphatic glands which are situated at the bifurcation of the trachea, between the right and left bronchus, or upon these tubes and their primary divisions.

General Description.—A short reference to the anatomical relation of these glands in connexion with their pathological and clinical history will be useful. Taking the bifurcation of the trachea as a starting-point, we find a group of glands in the space between the right and left bronchus. They are from ten to fifteen in number, and they vary in size from that of a small pea to that of an almond. The glands towards the right bronchus are larger than those towards the left. Glands are also situated upon the tubes; they are few in number and small. The vascular supply of the glands, which is free, is derived from the bronchial arteries, and the blood is returned to the bronchial veins. Afferent lymphatics reach the glands from the lungs, from the pleura, from the neck and other neighbouring parts. Besides these groups of comparatively large glands, numerous minute lymphatic glands are found in connexion with the primary divisions of the bronchi, chiefly at the back of these tubes, at their bifurcations, and at those of the pulmonary artery. The central group of glands is in relation in front with the pericardium, the arch of the aorta, and the pulmonary artery; behind with the pulmonary plexus of nerves, the œsophagus, the aorta, the vena azygos, &c. The ganglia on the upper, anterior, and posterior surfaces of the right bronchus are four or five in number and smaller than those of the central group. Their situation brings them into relation with the arch of the aorta, the innominate and subclavian arteries, with the brachio-cephalic vein, and with the vena azygos, the pneumogastric nerve, and its recurrent branch. The ganglia on the left bronchus are still smaller than those of the right side. Their position gives them relations with the arch of the aorta, the origin of the left carotid and subclavian arteries, the left branch of the pulmonary artery, with the large veins, with the left pneumogastric nerve, and especially with its recurrent branch. Lastly it should be stated, as a guide in clinical examination, that the bifurcation of the trachea takes place at the back in front of the body of the fifth dorsal vertebra, or between the fourth and fifth, and in front behind the lower end of the first bone of the sternum. The glands, except when diseased, are proportionately larger in children than in adult or aged persons. Knowing that these glands, in common with other lymphatic glands, are liable to such diseases as enlargement, abscess, morbid deposits, growths, and other textural changes, and bearing in mind, as just mentioned, their relations to surrounding organs, we can readily see how important is the study of their diseased conditions. Not only is their study important in reference to the diseased glands themselves, but also by reason of their modifying or masking the symptoms of disease in other organs, as the results of pressure which, when enlarged, they cause on nerves, air-passages, blood-vessels, &c. Throughout English and foreign medical literature numerous cases will be found described, in which there existed, more or less conspicuously, striking disease of the bronchial glands, little notice, however, being taken of less marked, though far more numerous, examples of disease. It is only within a comparatively recent time that the subject has received special attention and been discussed as a disease *per se.*

MM. Rilliet and Barthez, in their well-known *Traité des Maladies des Enfants*, have described the disease in infants, and Dr. West, in his work on *The Diseases of Infancy and Childhood*, has fully and clearly described—under the head of Bronchial

Phthisis—the tubercular diseases of these glands in young subjects. It is, however, to the late M. Noel Guéneau de Mussy, following up and widely extending the investigations of his predecessors, that we are especially indebted for our knowledge of the effects of these lesions, and to his pupil M. Baréty, who has published an exhaustive memoir upon them, under the title *L'Adénopathie Trachéo-bronchique*. The subject of disease of the bronchial glands has attracted the present writer's notice since (or even before) the year 1853, and the notes of more than sixty cases which have fallen under his observation will form the basis of some of the conclusions to be subsequently stated in this article.

Morbid Anatomy and Pathology.—The bronchial glands participate in the diseases which affect lymphatic glands generally, and which will be found described in a subsequent article (*see* Lymphatic System, Diseases of). In this place it will suffice to enumerate the principal morbid changes to which they are liable, and the effects which these changes produce.

a. The bronchial glands are liable to *congestion* with enlargement, as are glands in other situations. *Hypertrophy* will be the result of this last condition becoming chronic. The glands in this situation become after childhood almost invariably studded with black deposits, the quantity of which may be so considerable as to constitute *melanoma*.

b. These glands are liable to *acute* and *chronic inflammation*. Acute inflammation in this situation, terminating in *abscess*, is rare, but several cases of the kind have been recorded. A case of acute inflammation of these glands associated with double hydrothorax will be found described by the writer's friend the late Dr. Moxon in the *Transactions of the Pathological Society*, vol. xix. p. 572. Chronic inflammation of the glands is by no means uncommon. It may lead to permanent enlargement, to contraction and induration of the glandular textures, with the presence of calcareous particles, or to chronic abscess. The contents of the abscess may be more or less completely absorbed, leaving a partially filled *sac* or *cyst*, containing thick pus, or cheesy or calcareous matter. But these glands, when inflamed and enlarged, may form adhesions with surrounding parts, and the contents of an abscess, if it exist, may be discharged, by an *ulcerative* process, into the substance of a lung, into the mediastinum, into the trachea or œsophagus, or even into a blood-vessel. *General emphysema* has occurred in some cases; whilst the emptied sac has assumed in some instances the character of a *cavity* connected with the lungs. When the matter is discharged into the air-passages, *purulent expectoration* is the result. Two or three examples of the kind were noticed amongst the writer's cases, and the possibility of their being mistaken for the discharge from a cavity in the lungs, or an empyema, was remarked upon at the time. The abscess may discharge by a sinus in the neck or into the mediastinum. A remarkable instance of this kind is recorded in the case of the late much-lamented Dr. Fuller. A chronic abscess of the bronchial glands had opened into the posterior mediastinum. This led to pyæmia, to the formation of abscesses in the brain, and to the loss of a valuable life. Cases of great pathological interest illustrative of these points will be found recorded in the *Pathological Transactions*—in vol. xxv., p. 29, by Dr. Coupland; in vol. xxx., p. 254, by Dr. Barlow; in vol. xxxv., by Mr. Makins. In vol. xxxvi. Dr. Percy Kidd records two remarkable cases, in one of which sudden death was caused by the impaction of a caseous gland in the trachea, and a second case in which death resulted from profuse hæmorrhage caused by bronchial ulceration perforating the pulmonary artery, due to the pressure of a calcareous gland. In the same volume is recorded a case of suppurating bronchial gland by Mr. John Poland. Dr. Gee has recorded several cases of interest in vol. xiii. of *The Bartholomew's Hospital Reports*. The pressure of enlarged glands may cause dysphagia; and a series of cases illustrative of this point collected by Korne will be found noticed in the *Medical Chronicle*, vol. iii. p. 112. The pressure of enlarged glands on the pneumogastric nerve may have marked effects on the heart's action, causing great rapidity of the pulse or the contrary. *See* a Memoir by Dr. Marklen, *Bulletin des Hôpitaux de Paris*, tome iii., année 1887.

c. These glands are liable to suffer especially from *tuberculous* or *scrofulous disease*, from various forms of *malignant disease*, and in *secondary* or *tertiary syphilis*. Of the latter form of disease, some striking examples have fallen under the notice of the writer, in which symptoms closely resembling phthisis existed, but which yielded to treatment directed to the specific disease.

Ætiology.—The causes which give rise to disease of the lymphatic glands being discussed in another article, reference will here be made only to the special circumstances which influence the particular glands; and thus it will be sufficient merely to allude, amongst *predisposing causes*, to hereditary predisposition, to general impairment of health, and the like. With regard to the influence of age and sex, reference has already been made to the works of Rilliet and Barthez, of Dr. West, and of other authors who described the frequency of the disease in childhood. The writer's observations made on young persons and adults show that of 58 cases (of whom 21 were males and 36 females—in one case the sex was not recorded) 2 were under 10 years of age, 9 were between 10 and 20 years of age, 18 were between 20 and 30, and 26 were over 30 years of age. In three cases the age was not stated. If these observations justify any inference, it is that females are more liable to disease of the bronchial glands than males, and that the disease occurs with increasing frequency after the age of puberty. Amongst the *exciting causes* of disease in the glands we leave to be considered elsewhere those general conditions which give rise to disease in the lymphatic glands generally, such as scrofula, tubercle, malignant disease, &c., and pass on to the consideration of the more immediately *local* exciting causes. *Cold* leads frequently to congestion and enlargement of the bronchial glands. But it is to local irritation or inflammatory disease in organs or tissues with which these glands have a connexion that the source of disease may be frequently traced. As we find the submaxillary glands or cervical lymphatic glands enlarged from irritation or disease in the mouth or throat, or the axillary glands or inguinal glands enlarged from irritation or inflammation about the hands or feet, so we may find the bronchial glands enlarged temporarily or permanently from inflammatory disease in parts the lymphatics of which pass to these glands. They have also been observed to be enlarged in the course of or after certain acute specific diseases, such as scarlet fever, measles, and typhoid fever. In whooping-cough this enlargement has been so frequently observed by the late M. Guéneau de Mussy, that he believed this disease to be an exanthem of the bronchial mucous membrane, and that this local condition leads to enlargement of the glands, which, again, by pressure on the pneumogastric and recurrent nerves, gives rise to some of the special phenomena, such as crowing cough, and even to the vomiting so frequently observed in this disease. It is right to remark here that the late Dr. Hugh Ley speaks interrogatively, in his work on *Laryngismus stridulus*, of enlarged bronchial glands being capable of producing a cough like that of pertussis, and he further alludes to some cases of whooping-cough in which the glands by the side of the trachea were enlarged. He asks, 'May it not be that an enlargement of these glands from a specific animal poison, similar to that of the parotid gland in mumps, is after all the cause of whooping-cough?' (Note, p. 440.) The same author gives several striking illustrations of diseased bronchial glands pressing upon the pneumogastric and other nerves producing marked results. The black deposit so often found in the glands is the result of the absorption of carbonaceous or pigmentary matter from the lungs.

Symptoms.—The symptoms which have been recorded by the writer as more or less characteristic of the presence of enlargement of the bronchial glands are as follows:—

1. *Cough*, which is noted as being a prominent symptom in 39 cases. In 21 of these cases it was stated to have been the most troublesome of the symptoms present. In 6 cases it was described as harsh and laryngeal; in 4 cases spasmodic, resembling whooping-cough. In other cases, 5 in number, it was characterised as short and hacking, constant, incessant, and in one case the sound resembled that made by the peculiar cough of a sheep.

2. *Pain* is, in regard to the frequency of its occurrence, the next symptom recorded. It was mentioned as being present in 22 cases. The seat of pain was almost constantly referred to the situation of the fourth and fifth dorsal vertebræ, at one or both sides of the spinal column. The pain was mentioned in a few cases as existing only in front, beneath and at one or both sides of the upper end of the sternum and below the clavicles. The feeling was described in some cases (5) as of distressing tightness, and in one case as a 'spasm.' Tenderness on pressure over the seat of pain was very frequently observed. The persistence of the pain was very varied.

3. *Difficulty of breathing* was a noticeable symptom in several cases. In 13 it was recorded as being specially so; in 4 it had all the characters of spasmodic asthma, occurring at intervals and especially during the night.

4. *Difficulty of swallowing* was noticed in 10 cases; in one of these the difficulty was remarked especially in swallowing liquids.

5. *Hæmoptysis* was present in 10 cases. The amount of blood varied in these cases from marked streaks to copious expectoration, lasting two or three days. No case was recorded as presenting this symptom except on tolerably clear proof that it depended on bronchial gland enlargement, and on no other cause.

6. *Congestion* and puffiness of the face have been mentioned as present in 3 cases.

7. *Expectoration of mucus*, such as results from bronchial catarrh, was frequently present. Copious expectoration of pus was present in 3 cases. In each it resembled the contents of an ordinary glandular abscess, but mixed with air. In one of these the discharge was intermittent. The frequent occurrence of cough without any expectoration was remarked in many cases. Calcareous particles are mentioned also as having been expectorated.

8. *Loss of voice* (4 cases) and hoarseness (2 cases) are recorded as striking symptoms.

9. *Vomiting* is mentioned as having been present twice.

10. Lastly, the *position* assumed with least discomfort by the patient when in bed was noticed in 41 cases. Of these 23 rested on

that side on which the glands were mentioned as being chiefly if not wholly affected. In 15 cases an opposite condition was noticed. In 2 cases the most comfortable position was lying on the back. One patient, unable to lie down, sat when in bed, and stooped forward. One patient, a little boy, could only rest on his face and knees. This case was further remarkable in reference to the clearness with which the disease was recognised, and the successful result of subsequent treatment.

It might be mentioned here incidentally that the glands of the right side were noticed as being chiefly affected in 28 cases, and of the left in 22 cases, in 4 both sides seemed equally affected, and in 4 no record was made. The general or constitutional symptoms connected with the malady under notice need not be discussed here. They are in nowise peculiar, and will be found treated of elsewhere. The symptoms described above have special reference to the bronchial glands. The cough and its peculiar characteristics are, no doubt, in a great measure dependent on pressure or on irritation communicated to the pneumogastric nerves and their branches. So likewise pain and difficulty of breathing, in a great degree, through direct pressure on the air-passages, may also cause or aggravate these symptoms. Aphonia especially seems to have relation to the condition of the recurrent nerves. In one of the cases, which the writer saw with Mr. Lennox Browne, paralysis of the left chorda vocalis existed. The diagnosis of glandular disease was clear, a conclusion confirmed by the results of treatment. Vomiting is mentioned in two cases. M. de Mussy wrote that this is a more frequent result when the left pneumogastric nerve is pressed upon. He saw a connexion between the troublesome vomiting which occurs in some cases of tubercular disease of the lungs and like pressure upon nerves. The puffiness of the face and eyes noticed in these cases is due to pressure on the venous trunks, a condition which also accounts not only for some cases of hæmoptysis, but for bleeding from the nose, occasionally present. Copious and sometimes persistent hæmoptysis (profuse, as in the instance previously mentioned) has been traced to the perforation of a vessel by ulceration in connexion with disease of the glands.

Physical Signs.—The physical signs noticed in the 58 cases referred to were: 1. *Dulness.* This was present in 47 cases. It was found between the margin of the scapula and the spinal column at one or both sides, on a level with the fourth and fifth dorsal vertebræ. It varied in degree, and was more readily manifested when the muscles of the back were strained by folding the arms across the chest, and was often strikingly distinct when one side was contrasted with the other. Dulness was present in front in 8 cases (whether coincidentally with dulness at the back or not is not clearly stated), beneath the top of the sternum, and at each side below the sterno-clavicular junction. The dulness here was best elicited by the patient expiring deeply and holding the head backwards whilst percussion was being made.

2. *Flattening* of the affected side in front was mentioned in 3 cases. *Diminished mobility* of the affected side, chiefly independent of flattening, was recorded in 4 cases. Prominence in front was not recorded in any case, though, no doubt, it may occur.

3. The *respiratory sounds* were variously modified. Marked tubular breathing was recorded as being present over the seat of disease in 14 cases. In 10 the expiratory murmur was described as being very loud, various modifications of the inspiratory murmur being found at the same time. Feebleness of the respiratory murmur as a whole was noticed in 14 cases. In some this deficiency extended over the whole lung; in others it existed over the upper or lower portion of a lung, behind or in front. The observations made on the voice by the writer were few, but M. de Mussy and M. Lereboullet speak of a peculiar and increased reverberation of both the voice and the cough. Dr. Eustace Smith has described in the cases of children a venous hum, heard at the root of the neck when the head is thrown back, caused by the pressure of the enlarged glands on the venous trunks.

Diagnosis.—In the present article those cases are not kept in view in which the bronchial glands, becoming the seat of constitutional disease in association with other glands in the neighbourhood, constitute large and manifest tumours—such will be found described under another head (*see* Mediastinum, Diseases of). Nor is it intended to give prominent consideration to the state of the glands when they enlarge in acute disease—where the state of the glands plays a secondary part. The writer has been anxious to describe and to assist in recognising the presence of a condition in which the disease of the bronchial glands constitutes to some extent a disease *per se*, or gives rise to complications which it is important to discriminate. He believes the symptoms and signs above described will suffice for the purpose, always remembering that in the present and in all similar instances it is necessary to take means for excluding in our investigations diseases which may produce like phenomena. Thus we may find cough, pain, tenderness on pressure, and aphonia in a case of hysteria without any evident structural disease. On the other hand, a small tumour—say, a small aneurysm—may produce all the signs of pressure which are above given as the signs of bronchial gland-enlargement. It is the duty of the physician to recognise these differences and distinctions, to trace them to their origin, and thus establish as far as may be a knowledge of the nature of the disease under investigation.

Prognosis.—Prognosis will, as in like instances, so entirely depend on the nature of the disease, on its amount and its condition, on its relation to and effects on surrounding organs and textures, that each case must be regarded independently. It would be impossible to discuss the subject fully here—all that can be said is that the simple enlargements, or those resulting from specific diseases, generally yield to treatment, and within a reasonable period.

Treatment.—In several cases of morbid gland-enlargement, treatment has proved very effective. These cases would seem to be those of simple chronic enlargement. Many such cases have yielded to the use of iodide of iron in the form of pills or syrup, and to the external application between the shoulders of a solution of iodine, composed of equal parts of the tincture and the liniment of iodine. The same treatment has likewise proved very effective in cases in which a syphilitic origin for the disease could be traced. Symptoms such as cough, difficulty of breathing, pain, and loss of flesh and strength, &c., will all require more or less suitable treatment. The cough and difficulty of breathing may in some cases be relieved by simple expectorants or antispasmodics. A useful application when pain is a prominent symptom, is an embrocation composed of equal parts of chloroform, belladonna liniment, laudanum, and spirit of camphor. A couple of drachms of this composition sprinkled on the surface of impermeable piline, and applied over the painful part for a few minutes, often affords relief. Hypodermic injection of morphine may be required when pain is very severe. Under all circumstances it is necessary to improve the general health by wholesome diet, pure air, and the other conditions which will promote good digestion and a free elimination by the excreting organs.

Richard Quain.

BRONCHOCELE (βρόγχος, the throat; and κήλη, a tumour).—A synonym for goître. *See* Goître.

BRONCHOPHONY (βρόγχος, the throat; and φωνή, the voice).—The resonance of the voice, as normally heard on auscultation over those parts of the chest which correspond with the main bronchi, and, in certain morbid conditions, beyond these situations. *See* Physical Examination.

BRONCHO-PNEUMONIA.—A synonym for catarrhal pneumonia. *See* Lungs, Inflammation of.

BRONZED SKIN.—A peculiar discoloration of the skin, frequently associated with Addison's disease. *See* Addison's Disease.

BROW-AGUE.—A synonym for frontal neuralgia, or tic-douloureux. *See* Malaria; Neuralgia; and Tic-Douloureux.

BRUIT (*bruit*, Fr. a noise).—A word used to designate various abnormal sounds heard on auscultation, in connexion with the heart or vascular system. *See* Physical Examination.

BUBO (βουβὼν, the groin).—Synon.: *Apostema inguinis*; *dragoncelus*; Fr. *bubon*; Ger. *Leistenbeule.*—An inflammatory swelling of a lymphatic gland in any part of the body, whether caused by irritation or absorption, as in venereal disease; or referable to some constitutional affection, such as the plague. *See* Bubo, Venereal; and Plague.

BUBO, VENEREAL.—Definition.—An affection mentioned in the most ancient medical writings, but not properly distinguished in its several varieties until the present century. The term *bubo* is almost exclusively confined to swelling of the glands of the groin consequent on venereal irritation of the genitals, and will be so employed here.

Varieties.—Buboes are divided into:—1. *Simple bubo*, known also as *sympathetic bubo*, due to inflammation of a gland through ordinary irritation from an inflamed surface. 2. *Specific bubo*, the *chancrous* or *virulent bubo*, or an abscess inoculated with the pus of a chancre. 3. The indolent enlargement of the lymphatic glands accompanying the development of the initial sore of syphilis is, by some, called *syphilitic bubo*, though its formation is not due to active inflammation, and is quite distinct from the two forms just mentioned.

The glands first affected in the sympathetic and in specific bubo are always those in most direct communication with the sore. Further, according to Ricord, when chancrous matter has reached a gland through the absorbent ducts, it never passes beyond that gland into another more remote in the series. On the other hand, the effect of syphilitic absorption is general, and affects the glands of the group which are remote as completely as it does those which are nearest to the inlet of the poison.

Buboes occur most frequently on the side of the body occupied by the source of irritation; still they form not rarely on both sides, and sometimes only on the side opposite to the position of the exciting sore. When bubo forms in both groins, there is usually a sore on each side or one at the mesial line. The crossing of the irritant is due to anastomosis or interlacing of the lymphatic ducts at the mesial line. And when the glandular affection forms on the side opposite to the sore, there is want of communication with the glands of the groin on that side. Bubo, including simple and virulent, occurs in about thirty per cent. of chancres; how often with urethritis and other lesser venereal affections is not known.

1. **Simple Bubo.**—*Adenitis.*

ÆTIOLOGY.—This variety may be caused by mechanical irritation of the surface, such as erosions or fissures irritated by dirt or by caustic applications; by urethritis, balano-posthitis, or by a chancre when that acts only as a simple local irritant. Simple bubo is also often excited by herpes, erysipelas, boils, or other non-venereal irritants of the genitals. Lastly, though nearly all buboes can be traced to a lesion of the part where their absorbents arise, there are occasionally some observed for which such origin cannot be found. Some are caused by excessive sexual intercourse or excitement; they are met with generally among young lads and girls. Such are analogous to the inflammation of the inguinal glands which sometimes follows excessive straining of the muscles in long walks or rides. But it is also believed by one or two authorities that chancrous poison in rare instances has been absorbed along the lymphatic ducts without producing a sore on the surface. This may be, though extremely rarely, an actual occurrence. It has received the names of *idiopathic bubo* and *bubon d'emblée*.

SYMPTOMS.—There are two forms of simple bubo:—1. Slight swelling and tenderness of one or more glands, ending in a few days by resolution. This occurs most frequently in urethritis, balano-posthitis, or simple chafings. In genuine chancre the next and more serious form is most frequent. 2. Swelling, commonly of one, seldom of several glands; brawny thickening of the surrounding tissues; redness of the integuments; great tenderness and pain, especially when walking. In a few days this condition terminates either by abscess, the most frequent culmination, by gradual subsidence to the normal state, or by chronic induration of one or more glands. When the bubo suppurates, the matter, instead of pointing at once, may burrow in various directions among the layers of cellular tissue before it breaks through the skin. The pus of this form of bubo is always the ordinary pus of inflammation.

Some cases may terminate by gradual conversion into chronic fistulæ; or the glands may degenerate by tuberculisation with successive formations of abscesses around the tuberculous glands, with undermining of the skin.

PROGNOSIS.—This form of bubo is seldom dangerous, but always serious when it causes tuberculisation of the glands and burrowing; it is then often very tedious and exhausting to the patient.

2. **Specific Bubo.**—*Virulent bubo.* This is in reality an enormous chancre, identical in all but size with the sore whence it was inoculated. This form is never a consequence of gonorrhœa or of constitutional syphilis, but only of the local sore. It may be generated in two ways. 1. By touching the surface of a simple open bubo with chancrous pus. 2. By the absorption of chancrous pus along the lymphatic ducts leading from the chancre to the gland most directly connected with the sore. Two pathological facts prove the reality of this mode of origin. First, it has been observed that occasionally small circumscribed abscesses will form in the course of the lymphatic ducts before they reach the gland. When these little abscesses are opened they present the peculiar characters of the chancre. Secondly, when an efferent duct has brought chancrous pus into a gland, the abscess around the gland retains the ordinary phlegmonous character until the necrosing action going on in the infected gland lays open its interior, then contamination of the abscess takes place, and in a few days the abscess-cavity assumes the aspect of a huge chancre.

The conditions which assist or hinder the conveyance of chancrous pus along the lymphatic vessels are wholly unknown.

The proportional frequency of virulent bubo to the number of chancres is not known. It is far less frequent than simple bubo. It is said that women are less prone to it than men.

When not accidentally inoculated, virulent buboes are almost wholly confined to the groin, and originate in the gland which lies commonly in the centre of the group over the great blood-vessels. Occasionally, when the chancre is on the finger, a gland of the epitrochlear or axillary groups develops into virulent bubo. Hübbenet, of Kiew, experimentally inoculated a soft chancre on the cheek, which was followed by virulent bubo of the gland in front of the tragus of the ear. This bubo is generally unilateral; rarely are both sides of the body affected; in such cases the chancre is at the mesial line, or there are two chancres. Still more rarely the bubo forms at the side of the body opposite to that of the chancre. The time for appearance is generally in the first or second week of the existence of the chancre; but it may occur at any time while the chancre is spreading.

SYMPTOMS.—At first the symptoms of specific bubo are those of acute abscess forming rapidly round a single gland. Thus far they differ nowise from those of simple bubo. When the contagious pus reaches the abscess accidentally from without, or from within the gland by ulceration or incision of its capsule, the simple suppurating cavity becomes a spreading ulcer, which rapidly makes itself widely open by destruction of the integuments. The skin, thin as tissue-paper, gives way at several points, and lets out a large amount of matter, which is thin, yellowish-grey or yellowish-red, with shreds of a chocolate colour floating in it. When perforated, the skin breaks rapidly away until the cavity is widely exposed.

The further progress varies. In the least severe variety the edges of the skin ulcerate irregularly for a short distance, then thicken and begin to granulate; the floor of the ulcer loses its unevenness and rises up to the level of the skin; and cicatrisation follows. But commonly a much greater destruction of tissue is effected. The skin is eaten away into wide gaps; the floor burrows under the skin in long channels, or dives deeply among the great vessels. In other cases the ulceration produces a large shallow sore. The contagious condition of these buboes often continues for weeks or months, so that consecutive inoculation of the skin is not infrequent. The characters of the fully formed virulent bubo are those of the chancre. The surface is greyish-brown, dug-out, 'worm-eaten'; the borders at some parts are thickened, everted, and pared away, at others sharply eroded or undermined and curled in. The matter is thin, shreddy, plentiful, reddish in colour, and inoculable. Again like the chancre, the virulent bubo passes through periods of *extension*, *stagnation*, and *repair*. The virulent, as well as the simple bubo, is liable to erysipelas and inflammatory sloughing.

The *duration* of virulent bubo for the reason stated is wholly indefinite—in a few cases ending in a week, in many cases lasting for months.

Diagnosis.—The virulent bubo has in its early stage no distinguishing mark from the simple acute bubo. After it has become inoculated with the contagious matter it is distinguished from every other affection by the characters already described. The earliest signs of virulence are two: the matter which escapes when the bubo is lanced is thin and shreddy, and the edges of the cut become in a day or two eroded and partly covered by adherent sloughs. Subsequently other characters develop and remove all doubt. Nevertheless, in some cases the signs of virulence are so feebly marked throughout that the diagnosis remains uncertain. This difficulty may be increased by the primary sore having healed before the suppuration of the bubo, or by its being hidden in some unusual position (urethra, anus).

Prognosis.—This is not always grave. Virulent buboes often reach cicatrisation in a few weeks, and meanwhile cause no serious inconvenience. On the other hand, they are prone to inflammation; or if the patient have suffered from syphilis some years previously, the form of tertiary disease known as phagedæna may attack the ulcers, and thereby permanently cripple the patient, or even destroy life.

3. **Syphilitic Bubo.**—*Indolent multiple bubo; pléiade ganglionnaire.*—This enlargement of the group of lymphatic glands in nearest connexion with the initial sore is the constant, or at least almost constant, symptom of early syphilitic infection. In this it differs much from the bubo of chancre or gonorrhœa, in which affections the bubo is more often wanting than present. Four conditions have been noted to exist in patients in whom the enlargement of the glands could not be detected, namely:—1. Phagedæna of the sore. 2. Obesity; in such persons the lymphatic system as a rule is small. 3. Second infection; *i.e.* a primary sore on a patient who has had constitutional disease before. 4. Scantiness of the induration of the primary sore, the sore itself being ill-developed. But these exceptions are most rare. Fournier gives five instances only of absence of indolent multiple bubo in 265 cases of hard sore, accompanied by well-marked general syphilis; or 2 per cent. In 176 similar cases noted by the writer, three had no apparent inguinal enlargement. One of the patients was a very fat man, and in another the initial sore was only slightly hardened.

The seat of this bubo is, in the great majority of cases, the groin, whither, besides the lymphatic ducts of the external genitals, those of the anus, perinæum, buttocks, and lower part of the abdomen are directed. But the glands of other regions—epitrochlear, axillary, sub-maxillary, buccal, cervical, and nuchal—are all occasionally found primarily enlarged when the syphilitic poison enters the body through the regions whence their absorbent ducts are derived.

In the groin the bubo is generally *double*, that is, the glands are enlarged in both groins, those on the side of the sore being most affected. In a few cases only the glands situated on the same side of the body as that of the sore enlarge, and in rare examples only those of the side opposite to that of the sore. This enlargement affects the group widely, for when the deeply-placed glands can be examined they are found to be similarly enlarged along the iliac vessels and lumbar vertebræ.

The enlargement of the glands is first perceived about eleven days after the induration of the sore, though probably the affection commences at the end of the incubation of the poison. In extremely rare instances enlargement is delayed until the third or fourth week after the induration of the sore.

Symptoms.—The distinguishing marks of this bubo are swelling, not inflammatory, and rarely surpassing an almond or a hazel nut in size; gristly hardness; ready isolation and mobility; insensibility to pressure; natural hue and condition of the overlying skin; and absence of fulness of the cellular tissue.

The gland in most direct communication

with the sore is most enlarged; in rare exceptions only a single gland is enlarged. Copious enlargement of the glands does not always attend copious induration of the sore, nor is scanty induration of the sore always accompanied by small swelling of the glands, though commonly this is the case. So also, though absence of tenderness is the rule, the glands may be slightly painful if pressed. Again, though the glands remain distinct in most cases, they have been known to coalesce into a single mass, which becomes fixed to the fascia. In many patients the dorsal lymphatic vessel of the penis becomes indurated sufficiently to be easily distinguished under the skin.

This bubo reaches full development in one or two weeks, and remains without apparent change for several weeks, or even for two or three months. Then it begins to diminish slowly, but is generally still evident in the fifth or sixth month after infection, and now and then even for years afterwards. In rare cases the enlargement vanishes in two or three weeks. The long duration of enlargement renders this bubo a valuable sign of constitutional syphilis when the primary sore has disappeared. Again, the conspicuous enlargement of a group of glands may indicate the place of entry of the syphilitic poison when that is hidden.

Terminations.—In most cases the glands revert to their natural state. Sometimes they degenerate into masses of fibrous tissue. Now and then suppuration takes place, not from the syphilitic change, but from ordinary irritation, and then it produces a simple phlegmonous abscess. A further change is apt to occur in tuberculous persons. The glands enlarge still more, grow soft, and coalesce; presently matter forms in the thickened cellular tissue around the glands, and the further progress becomes that of tubercle.

Diagnosis.—This is generally easily drawn from the character of the swelling, aided by the presence of other syphilitic signs (hard sore, rash on the skin, &c.). This bubo may be confounded with chronic inflammatory enlargement, but in such cases the history and attendant symptoms remove doubt.

Prognosis.—Apart from its connexion with syphilis, the prognosis is good. The only untoward termination is tuberculous degeneration.

Treatment.—1. *Simple acute bubo*, from whatever cause it may arise, demands the treatment of acute abscess. In the early stages, antiphlogistics, rest in bed, the constant application of a cream made of equal parts of extract of belladonna and glycerine, warm poultices, fomentations, and baths, sometimes even leeches, are requisite. Caution must be observed in applying leeches if chancre be present, lest the bites be converted by inoculation into chancres. The leeches should be applied at the circumference of the swelling, so that they may be removed as far as possible from the centre where pointing is most probable. If suppuration arrive more speedily than was expected, and the bubo prove a virulent one, it is best to open it freely and trust to antiseptics, such as iodoform, to prevent the inoculation of the bites.

When active congestion has ceased and matter has not formed, the subsidence of the glands may be aided by pressure with a pad and spica bandage. Stimulating ointments and plasters, iodine, and similar preparations are of doubtful service, and may possibly rekindle the inflammation. When pus has formed, it should be let out by a vertical incision at once. The proper drainage of the cavity should be ensured by making the incision long ($\frac{3}{4}$ in. usually), and by placing a bit of drainage-tube between the edges of the incision during the first twenty-four hours. Early evacuation checks the undermining of the skin and prevents burrowing. When matter forms at several points, a small incision should be made at each fluctuating point. When free exit has been given to the pus, the groins should be dressed with boracic lint soaked in hot water; and when swelling is gone, the surfaces may be covered with boric acid ointment and overlaid by a thick compress and spica bandage; which, slackly applied at first, may be tightened as the swelling subsides.

2. The *chancrous bubo*, not being distinguishable from ordinary sympathetic bubo during the inflammatory swelling and consequent suppuration, requires the same treatment—sedatives and an early single incision. By early incision the cavity of the abscess, subsequently the chancrous ulcer, is kept as small as possible; by a single incision the number of chancres is restricted. Occasionally, but only when the abscess has already undermined the skin, more than one incision is necessary. Caustics have no advantage over the knife for opening the abscess, while they make a larger gap. When the abscess has been opened and the chancrous nature is suspected, a free cut should be made, and the cavity should be well cleared at the time by injections—of one part of carbolic acid to sixty of water, for example, or of 5–10 grains to the ounce of nitrate of silver, or of tartarated iron, or of some other astringent and disinfectant, and the interior well dusted with iodoform. The injection may be repeated three times in the first twenty-four hours; and constant drainage maintained by a drainage-tube and a compress of Lister's antiseptic gauze or boracic lint. Should these precautions fail to prevent the conversion of the abscess into a chancre, it must then be dressed as a chancre. It must be sedulously washed by injection twice daily, dried by careful mopping with bits of cotton-wool, and well dusted and packed with iodoform in

powder; the whole cavity being loosely filled with pellets of cotton-wool, and compressed gently with a layer of boracic lint and a bandage. Should this fail, as it sometimes will, caustic may be applied. The caustics most suitable are the strongest and most penetrating, such as Vienna paste, acid nitrate of mercury, Ricord's paste (powdered charcoal and the strongest oil of vitriol). To apply the caustic thoroughly the patient should be anæsthetised. If the least part of the surface is left undestroyed, that will reinoculate the whole. Before cauterising, it is well to scrape the surface thoroughly with Volkmann's sharp spoon. Complete cauterisation is practically very difficult to accomplish, hence caustics should be reserved for the cases where iodoform, which is painless, fails. Overlapping bands of skin should be divided, that the dressing may be fairly applied.

Phagedæna.—When the ulceration by its obstinacy deserves this title, plan after plan of treatment must be tried till the destruction of tissue is arrested—caustics being reserved for the last. To the local treatment of phagedæna that for syphilis should be added. The patient should be brought under the influence of mercury as quickly as possible, by giving two or even three grains of blue pill thrice daily, or by the injection into the thick muscles of the trunk of some suitable mercurial solution, such as that of Raggazzoni (bichloride of mercury, 1 part; iodide of sodium, 1 part; distilled water, 64 parts: 8 minims being a dose). When the patient's general health is good, the ulceration seldom fails to yield to iodoform, applied thoroughly in the manner directed. While the nocturnal gnawing pain continues, the patient should be narcotised with opium or other narcotic. The cessation of pain is a signal that the eroding action has stopped. When iodoform alone is insufficient, the continuous warm hip-bath must be employed. By it pain is at once arrested and healing soon set in motion. As continual immersion in a bath becomes extremely irksome in many cases, the ulceration may be arrested by keeping the patient in water for sixteen hours every day, and allowing the night to be passed in bed—in this interval the wound should be carefully packed with iodoform. When the ulceration is stopped, the bath may be discontinued and iodoform alone used. If the water-bath fail (and such a result has not yet happened during a considerable employment of this method at the Male Lock Hospital), caustics may then be used.

The strength of the patient, generally much exhausted, should be restored by tonics, good diet, stimulants, and other general means.

3. The *syphilitic bubo* usually causes no trouble, and gets well during the course of treatment which is carried out for the cure of the general disease. If tenderness or aching occur, rest and a few warm baths are sufficient. If suppuration takes place the abscess must be incised and poulticed. The tuberculous degeneration is best met by remedies against the diathesis—iodide of ammonium or of iron, cod-liver oil, nutritious food, sea-air, and other tonics. Mercury, in $\frac{1}{10}$-grain doses of the bichloride, combined with the iodide of sodium or with solution of perchloride of iron, may be added to the treatment. Locally, the abscesses and sinuses must be emptied as fast as they form and cleared by dissecting the diseased glands away and scraping their sites with the sharp spoon.

Abortive treatment of bubo.—This once favourite method of treating buboes has fallen into disuse as the varieties of bubo have been better understood. The chronically enlarged glands of syphilis have little or no tendency to suppurate, but subside spontaneously if let alone. Others only suppurate when freely irritated, hence the best abortive treatment is to guard against the increase of irritation, and assuage that which exists by antiphlogistics. In the bubo virulent by absorption suppuration is inevitable. Thus, the sympathetic bubo is the only one which can be acted on by abortive treatment. To antiphlogistics may be added counter-irritants, but these are uncertain in their effect. Those least open to objection are vesicants, and the form most beneficial is repeated 'flying' blisters. By this means a series of small blisters are produced round about, not over the swelling. Any other plan is most uncertain—painting the part with tincture of iodine, or other mild irritant, is simply waste of time.

Compression is of great value for reducing indolent enlargement, or for removing the boggy condition of the groin where several abscesses have formed, with more or less undermining of the skin. It is useless for syphilitic bubo and mischievous for the virulent bubo. The simplest and most effectual method of applying compression is by a graduated compress of lint kept firmly in place by a spica bandage of calico, or of elastic tape. For abscesses, careful packing may be added to the compress. Each focus of pus must be laid open, and bridges or tunnels cut across, so that narrow strips of lint soaked in liquor plumbi subacetatis and lightly pressed between the fingers, to drive out the dripping excess of fluid, may be laid into the hollows and under overhanging borders of skin. The strips must be renewed every day at first, and the cavities well cleared by syringing with water. In a few days, when the discharge is very small, the strips may be left for three or four days unchanged. The first application is painful, but very soon an insensible crust is formed over the ulcerating surface, and fresh applications cause no discomfort. As soon as healthy granulations are formed the plugging should be laid aside.

If the glands do not shrink in size after a fair trial of the methods already described, the patient should be anæsthetised, the glands scraped away by the sharp spoon, and the wound well spread with iodoform.

Berkeley Hill.

BULB.—A synonym for the globe of the eye, and also for the medulla oblongata. Its adjective, BULBAR, is commonly restricted in application to the latter, and has for a considerable time been commonly thus employed, as in the terms 'bulbar symptoms,' 'bulbar nerves,' and the like. This use of the adjective has led to a more extensive employment of 'bulb' for the medulla oblongata, because the term 'medulla' is also applied to the spinal cord, the 'medulla spinalis,' as well as in its general sense of 'marrow.'

BULBAR PARALYSIS.—A synonym for labio-glosso-laryngeal paralysis; derived from the pathological relation of the disease with the bulb or medulla oblongata. *See* Labio-Glosso-Laryngeal Paralysis.

BULIMIA (βου, a prefix signifying excess; and λιμός, hunger).—Excessive or voracious appetite. *See* Appetite, Disorders of.

BULLA (*bulla*, a bubble).—*See* Blister.

BURGHERSDORP, in Cape Colony. *See* Africa, South.

BURNS.—The morbid local effects produced by the direct application of excessive dry heat. *See* Heat, Effects of Severe or Extreme.

BURSÆ MUCOSÆ, Diseases of.—Bursæ mucosæ are spaces in the connective tissue lubricated with a small amount of serous fluid, and situated at points exposed to repeated pressure or friction. Structurally they are composed of a layer of condensed cellular tissue, fusing externally with the areolar tissue of the part, and lined internally with an imperfect layer of flattened endothelial cells, similar to those found in the pleura or peritoneum. Some bursæ, as that over the patella, that under the deltoid, those about the great trochanter, and many others, are constantly present; but new bursæ, equally perfect in their structure, may form at any part exposed to abnormal pressure and friction, as over the outer malleolus of a tailor, under an old corn, or over the head of the metacarpal bone of the great toe (*bunion*). Like the great serous cavities, bursæ are in direct communication with the lymphatics, and inflammatory products are consequently absorbed from them with great readiness, often giving rise locally to a diffuse inflammation of the surrounding cellular tissue, closely resembling phlegmonous erysipelas in appearance, and always accompanied by high fever.

Bursæ are liable to four kinds of disease:—

1. **Acute inflammation and suppuration—Acute bursitis.**—This is usually the result of some more or less violent mechanical injury. It may occur in any bursa, but is most common in the bursa patellæ, those about the hip and over the olecranon, and in the small false bursa formed beneath an old corn, or in a bunion. The symptoms are those of acute inflammation generally, but the redness and swelling often extend a remarkable distance up and down the limb. Thus, a drop of pus beneath a corn may cause œdema and redness to the knee. The febrile disturbance is usually proportionately severe. About the trochanter the abscess may assume a chronic form.

Treatment.—Hot fomentations, and the application of glycerine and extract of belladonna (equal parts), may be of use. It is very important that pus shall be let out early, or it may burrow extensively, especially about the knee. Antiseptic treatment will be found especially useful in the treatment of suppurating bursæ.

2. **Chronic Bursitis—Dropsy of the bursa.**—This consists of an accumulation of serous fluid distending a bursa more or less tensely. The wall becomes somewhat thickened and opaque, but is otherwise unchanged. The fluid is clear, straw-coloured, and albuminous in character. The cause of the disease is usually repeated slight mechanical injury, but in some cases it may be due to some of those obscure conditions spoken of as 'rheumatism.' The symptoms are merely those of a collection of fluid in the situation of the bursa, perhaps accompanied by a feeling of weakness in the neighbouring joint. There is no pain or tenderness. The commonest form of this disease is the so-called 'housemaid's knee,' but it is not infrequent in the bursa of the popliteal space.

Treatment.—Avoidance of the mechanical injury, whatever it may be, which has caused the disease, is most important. The swelling may be painted with tincture of iodine twice a day for some weeks, or a series of small blisters applied over it. If this fails, an incision may be made into the swelling under antiseptic precautions, and a small drainage-tube introduced for a week or ten days. But before either of these means is adopted, care must be taken to ascertain that the bursa does not communicate with the neighbouring joint. In the ham it is safer as a rule not to operate, except by means of the aspirator.

3. **Chronic enlargement of the bursa, with fibroid thickening of its walls.**—This affection is most common in the bursa patellæ, but may occur in that situated over the tuberosity of the ischium. The bursa becomes converted into a dense fibroid mass of almost cartilaginous hardness. On section it is found to be composed of concentric layers of dense fibroid tissue. There is usually a small central cavity containing a little fluid. The cause of this change, as of simple dropsy,

is repeated mechanical injury of a slight nature. In some cases it seems to be connected with syphilis. The only treatment is removal by the knife.

4. Chronic enlargement of the bursa, with the presence in it of the so-called melon-seed bodies.—In this form of disease, in addition to some thickening of the wall and accumulation of fluid in the bursa, small oval, flattish, smooth bodies of a white colour are found floating freely in its interior. These are similar in nature to those found in some forms of ganglion (*see* GANGLION). This condition is recognised by the peculiar soft crackling feeling perceived on palpation, combined with the ordinary symptoms of an enlarged bursa.

TREATMENT.—The affected bursa may be dissected out; or it may be laid open, emptied, and drained. The closure of the cavity may be insured by the application of pure carbolic acid, so as to destroy the lining membrane. MARCUS BECK.

BUXTON, in Derbyshire.—Simple thermal waters. *See* MINERAL WATERS.

BUZIAS, in Hungary.—Strong muriated chalybeate springs. *See* MINERAL WATERS.

C

CACHEXIA (κακός, bad; and ἕξις, a habit or constitution of body).—SYNON.: Fr. *Cachexie*; Ger. *Kachexie.*

DEFINITION.—A chronic state of ill-health associated with impoverished or depraved blood, arising from malnutrition, persistent loss of blood-elements, or the presence of a morbific agent.

In such diseases as tabes mesenterica, lymphadenoma, and the like, the patients become cachectic from direct depravation of the blood, in consequence of disease of organs which are importantly concerned in its nutrition and elaboration. In other diseases persistent loss of blood-elements arising from chronic suppuration or from repeated hæmorrhages (especially observed in some uterine conditions) induces a cachexia which is well described by the term *secondary anæmia.* Again, certain poisons introduced from without, and nurtured within the body, may produce marked cachexia. The syphilitic and malarial poisons are good examples of the first kind. Of cachexiæ produced by the presence of morbific agents which have been generated within the body we may instance those arising from defective elimination, as the uræmic and gouty cachexiæ from inadequate functional activity of the kidneys and liver. In the latter connexion it should be noted that, as has been hinted by Sir James Paget in reference to cancer, the malignant cachexia may arise from blood-contamination with the waste products yielded by the morbid growth in the process of its nutrition; such a growth not only abstracting material from the blood for its nutrition, but also contributing effete material to it.

It must be further observed that in the opinion of some pathologists the term cachexia implies much more than the secondary anæmia consequent upon the ravages of a given local or general disease upon the system. It rather signifies the morbid constitution which *is* the disease, and which may precede its local manifestation. Thus we may have the cancerous cachexia, culminating in scirrhus of the breast, the tubercular cachexia in pulmonary tuberculosis, and the like. It is thus evident that with many observers the terms *cachexia* and *constitutional disease* have the same significance.

R. DOUGLAS POWELL.

CACOPLASTIC (κακός, bad; and πλάσσω, I mould or form).—A term applied to products of inflammation which are more or less incapable of organisation.

CADAVERIC (*cadaver*, a dead body).—This word signifies 'belonging to the dead body'; and it is applied to the aspect, colour, odour, and other phenomena resembling those of death, which are sometimes observed in the living subject.

CÆCUM, Diseases of.—SYNON.: Fr. *Maladies du Cæcum*; Ger. *Blinddarmkrankheiten.*—The structural peculiarities and anatomical relations of the cæcum are specially favourable to the occurrence of the diseases to which this part of the large intestine is most liable, viz. (1) *accumulation of solids* (fæces, foreign bodies, &c.); (2) ulcerative *inflammation,* typhlitis, &c.; and (3) *dilatation, contraction,* and *perforation.*

1. Accumulations.—Hardened fæces, biliary and intestinal concretions, foreign bodies, stones of fruit, balls of worms, and also gases resulting from decomposition, are apt to collect in the cæcum, and cause varying degrees of local disturbance. Sometimes, as in elderly patients of torpid habit, the cæcum is found loaded with fæces, without inducing pain or other signs of inflammation. The right iliac region may be full and hard, and in it may be felt a well-defined, almost painless, doughy uneven mass, of the shape of the cæcum. As a rule, however, sooner or later the accumulation leads to one or more of the following results:—

(*a*) *Obstruction of the bowels.* This may be partial, as in the various degrees of constipation, or complete. When complete, it may even prove fatal—*e.g.* from perforation or rupture, without the cæcum or peritoneum exhibiting signs of inflammation. On the other hand, general peritonitis supervening, obstruction in the cæcum may be quickly obscured; still, however, the chief pain and tenderness may be found in the right iliac region. (*b*) *Pressure* on adjacent nerves, vessels, or other structures, producing numbness and œdema of the right leg, retraction of the right testicle and other symptoms. (*c*) *Inflammation and Ulceration*: stercoral ulcer, cæcitis, typhlitis, peritonitis.

It is of clinical importance to bear in mind that the cæcum, when overloaded or enlarged, may occupy an unusual position, *e.g.* a site between the right and left iliac regions, or may descend somewhat into the pelvis and press on the urinary bladder.

Tympanitic distension of the cæcum is generally associated with some fæcal accumulation or obstruction in the colon or other part of the large intestine. *See* FÆCES, Retention of; and FLATULENCE.

2. **Inflammation.**— SYNON.: Cæcitis.— Until recent years inflammation of the walls of the cæcum has been designated by the term, Typhlitis; but this is no longer applicable, for it has been shown that the symptoms of what is clinically recognised as typhlitis do not depend on inflammation of the cæcum, but on inflammation of the peritoneum investing the cæcum and vermiform appendix (*see* TYPHLITIS). The mucous membrane of the cæcum is liable to catarrhal inflammation, from the lodgment of fæces, indigestible matters, and foreign bodies; but the symptoms induced by it are, as a rule, ill-defined, and generally resemble those of colitis (*see* COLON, Diseases of). It may, however, lead to ulceration, which may ultimately involve the outer wall of the cæcum and the peritoneum, and thus induce typhlitis.

3. **Dilatation, Contraction, and Perforation.**—The cæcum may be (1) *dilated*, from accumulation within it of solids and gases, or from obstruction in the colon; (2) *contracted*, from growths (polypi, cystic tumour, cancer, &c.), or cicatrisation of ulcers (tubercular, dysenteric); or (3) *perforated*, from ulceration (stercoral, enteric, tubercular, cancerous, dysenteric), from tearing of the wall by over-distension, or from a typhlitic abscess (originating in the appendix vermiformis) opening into it.

GEORGE OLIVER.

CALCAREOUS DEGENERATION.

A form of degeneration characterised by the deposit in the tissues of earthy salts, especially those of lime. *See* DEGENERATION.

CALCULI

CALCULI (*calx*, chalk).—DEFINITION. The term calculus is now applied to any kind of concretion formed in the ducts or passages of glandular organs; though older writers limited its employment to the designation of concretions met with in the kidneys and urinary bladder.

VARIETIES.—The following is a concise summary of the principal calculous concretions met with in the human body, given in their alphabetical order.

1. **Biliary Calculi.**—Biliary calculi vary considerably in size, number, form, and composition. In size they range from minute grains about the size of a pin's head to a mass as large as a hen's egg. The smaller they are, generally, the larger is their number. Their form is very various. When solitary they are usually round or oval; when numerous they are generally more or less irregular in shape, their surfaces being flattened and faceted from compression. The colour is usually a blackish-green or brown, less frequently yellow or greyish-white. In consistence, some are soft like wax; others hard, dry, and friable. On section they will be found to differ widely—some being granular, and made up of sub-morphous particles without any apparent nucleus; others crystalline, the glistening white crystals (cholesterin) radiating from a central nucleus, which is frequently found to consist of inspissated bile. Biliary calculi consist of two kinds. (*a*) Those of the one group are formed of cholesterin and bile-pigments, mixed with a variable proportion of insoluble organic matter, fatty matter, stearate of lime, and traces of the earthy phosphates. To separate the cholesterin, finely powder the gall-stone and thoroughly exhaust with ether; the ethereal solution on evaporation yields amorphous cholesterin. To obtain it in the crystalline form, it must be redissolved in boiling alcohol, which on cooling deposits it in characteristic, glistening, rhombic plates. The pigmentary matters can be obtained by exhausting the residue of the crushed gall-stone, from which the cholesterin has been removed, successively with water, alcohol, and dilute hydrochloric acid. The dried residue is then boiled with pure chloroform for some time, and the chloroform extract is distilled to near dryness, and several volumes of alcohol are added, which throws down bilirubin. Bilirubin thus obtained is an orange-red powder, insoluble in water and ether, slightly soluble in alcohol, but very freely soluble in chloroform. On passing a current of air through an alkaline solution of bilirubin the solution acquires a green colour—biliverdin. According to Städeler, biliverdin is formed from bilirubin by the addition of one atom of water in the presence of oxygen. A brown pigment, bilifuscin, can also be obtained by acting on bilirubin with strong sulphuric acid. (*b*) Calculi of the other group are composed

solely of one substance: such are the small white pearly calculi, frequently passed by young children and very old persons, and which consist entirely of cholesterin; small black masses like dried tar which consist of pigment; and brownish, irregular fragments which are formed solely of stearate of lime.

2. **Intestinal Calculi.**—Intestinal calculi are rare in man and carnivorous animals, but are not uncommon in herbivorous animals. They consist almost entirely of ammonio-magnesium phosphate, calcium phosphate, and calcium carbonate, deposited round a nucleus, generally a fragment of some indigestible material of the food, such as stones of fruit, husks of grain, or portions of bone. There is a kind of intestinal calculus occasionally met with among Scottish and Lancashire people, who use oatmeal largely as food, which is chiefly composed of the hairs and fragments of the envelopes of the oat, encrusted with calcium phosphate and carbonate. Magnesium carbonate when taken habitually and in bulk is apt to accumulate in the bowels and concrete there; there is now less risk of that danger since the fluid forms of magnesia have come into such general use.

3. **Pancreatic Calculi.**—Calculi in connexion with the pancreas are the rarest of all glandular concretions. When found they are generally numerous, being met with in the main duct, the accessory duct, and even in the smaller radicles. The size varies greatly, the largest that has come under the writer's observation being quite one inch in length. They are generally oval in shape, and their surface has frequently a worm-eaten appearance, of whitish colour, which when rubbed acquires an enamel-like lustre. When broken, the fracture often presents a white, glistening, porcelain appearance. One calculus analysed by the writer gave a percentage composition of organic matter 24, fixed inorganic salts 76. The bulk of the fixed inorganic salts consisted of calcium carbonate, calcium phosphate being present in much smaller proportion.

4. **Prostatic Calculi.**—Prostatic calculi consist essentially of calcium phosphate and calcium carbonate, though incidentally traces of uric acid, calcium oxalate, and ammonio-magnesium phosphate may be found. They occur in three forms, namely (*a*) small, rough concretions, from the size of a pin's head to a hazel-nut; (*b*) irregular masses with porcelainous appearance; and (*c*) large regular concretions. The quantity of earthy matter that may be deposited in the prostate gland is often enormous. When the calculi are of the small variety, fifty or sixty may be present, and a gland may feel like a bag of nuts. The Hunterian Museum contains a specimen showing the enormous size these concretions may attain. *See* Prostate, Diseases of.

5. **Salivary Calculi.**—These are generally rough externally, irregular in shape, and are usually found near the orifice of the duct, which they obstruct. The nucleus frequently consists of some foreign body which has accidentally found its way into the duct, as a splinter of wood or a fragment of bone. Their chief component is calcium carbonate, of which they contain more than any other kind of concretion, and traces of earthy phosphates.

6. **Urinary Calculi.**—Urinary calculi vary considerably in size, form, colour, and general appearance, according to their composition. The constituents that form these stones are uric acid, urates, cystin, xanthin, calcium oxalate, calcium phosphate, magnesium phosphate, ammonio-magnesium phosphate, calcium carbonate, and also concretions of blood and fatty substances (urostealith). Any of the above-named substances, combined with a varying proportion of organic matter, may constitute the sole ingredient of a calculus; more commonly, however, two or more are associated together. To fully ascertain the composition of the mass of the calculus it must be sawn across, and if made up of different layers, a portion of each layer must be analysed. *See* the articles on the several kinds of urinary calculi; and Urine, Morbid Conditions of.

Pathology.—The manner in which these concretions are formed, especially renal and urinary calculi, has long been a matter of speculation with physicians, some regarding them as of purely local origin, others endeavouring to show that they are the result of some peculiar diathesis, wherein uric acid, the phosphates, &c., are formed in the body so profusely, and are eliminated in such quantities as to be precipitated in the passages. The researches of Ord and Carter have thrown much light on this obscure subject. They have shown that the particles constituting the bulk of the calculus are not mere accretions, formed in the urinary passages by a process of chemical precipitation, in the presence of blood, mucus, &c.; but consist of structures, designated as 'submorphous'—granules, spheroids, laminæ, &c.—and which require considerable time for their formation. They have shown that this modification of form, *i.e.* the change from the crystalline to the submorphous type, can be artificially produced by allowing two saline solutions to intermix slowly through a colloid medium; as gum, albumen, &c.; the more slowly the mixture is effected and the denser the colloid, the more perfect is the change to the submorphous condition. On the other hand, if the colloid medium is attenuated, and the admixture rapid, the crystalline form is more or less retained. The nature of this colloid medium has not been clearly made out. The fact that calculus rarely accompanies Bright's disease shows that the ordinary effusion of blood or albumen into the renal tubules does not furnish the necessary medium. Indeed, if simple effusion of fibrin, or increased secretion of mucus, furnished the colloid, calculus, instead of being comparatively a rare disease, would be extremely common. Some authors have regarded the 'entangling mucus' as the product of a specific catarrh. Thus Meckel speaks of a stone-forming catarrh (*steinbildendender Katarrh*); and the late Dr. Owen Rees pointed out that among the evils attendant upon gout is 'a tendency of mucous membranes to secrete a viscid mucus, which modifies the ordinary crystalline character of uric acid, causing it to appear in agglutinated masses, which adhere to the sides of the urinary passages.' In speculations as to the origin of stone, too little attention has as yet been paid to the condition of the renal cells. These cells normally eliminate the urinary constituents; and it is not difficult to imagine that under certain conditions of vital impairment these substances may be retained and deposited, instead of being eliminated, the cell itself furnishing the colloid medium. The objection urged against this view is that recent observers have discovered no satisfactory signs of cell-structure in the matrix of calculi; but this objection can hardly be considered fatal, since the accretion of particles within the cell would gradually destroy the cell-structure. Professor Quekett, however, figured (*Med. Times*, vol. xxiv. p. 552, 1851) crystals of calcium oxalate and triple phosphate contained in cells taken from human tubuli uriniferi; and though his observations have not been confirmed by others, still the accuracy of his work has never been questioned, and it may be when the tubuli uriniferi of persons dying of calculous affections come to be more frequently examined by pathologists, cells containing calculous constituents at an early stage of deposition may be observed—that is, before the cell-wall is destroyed. It is a remarkable fact that calculous deposit commencing in the kidney tubules is rarely met with in the convoluted portion of the tubule, but invariably occurs at the apices of the mammillary processes, the extremities of the ducti papillares. Now less blood circulates through this portion of the kidney than through any other part of it, and moreover in the ducti papillares the basement membrane (tunica propria) disappears and the wall consists of epithelium alone. May not these anatomical differences render the cells of this part of the tubule more liable to calculous deposit—in short, to undergo calculous degeneration?

C. H. Ralfe.

CALIPERS.—An instrument employed for measuring diameters, used more especially in clinical medicine for measuring the diameters of the chest. *See* Physical Examination.

CALVITIES (*calvus*, bald).—Synon.: *Alopecia calva.*—A synonym for baldness. *See* Baldness.

CANARIES, The, in North-east Atlantic Ocean; Teneriffe.—Mean temperature in winter, 64° to 85°. Warmer, drier, but more variable, than Madeira. East winds from Africa. *See* Climate, Treatment of Disease by.

CANCER (*cancer*, a crab).—Synon.: Carcinoma; Fr. *Cancer*; Ger. *Krebs*.

Definition.—The word cancer is without histological meaning. We find it and its synonym *carcinoma* used as long ago as the time of Hippocrates, and the latter term was then, as is the former at the present day by the vulgar, applied to any new-growth of a malignant character. The name originated in the large ramifying veins and puckered furrows which spread from a cicatrising cancer that is involving the skin. When the broad distinction between the epithelial and connective-tissue type of tumours was established by Virchow and others, it was decided to retain the word *cancer* as the name for the more malignant or epithelial growths; while the equally meaningless but less formidable word *sarcoma* has been, from this time, confined to those tumours which have connective tissue for their type. *See* Tumours.

In this sense of the word the cancers form a class which is, on the whole, easily distinguished by definite microscopical and clinical characters; but at two points, at least, the difference from simpler growths is almost imperceptible. First, as a matter of accident, one sarcoma (the alveolar) resembles a cancer so closely in microscopical structure, that it is impossible to distinguish between them without reference to clinical facts; and, in the second place, as cancers are essentially depraved modifications of epithelial, epidermic, or glandular structures, they may be found to differ so slightly in histological characters from simple hypertrophies, that the fact of ultimate malignancy is often all that can decide between, say, a papilloma and an epithelioma, a glandular cancer of the rectum and a simple polypus, or a scirrhus of the breast and a chronic mammary tumour.

Histological Structure.—Histologically, cancers are distinguished by consisting partly of cells of an obviously epithelial origin and partly of connective tissue. The connective tissue forms alveolar spaces, and may vary in structure from a loose fibro-cellular material to strong and old fibrous tissue. The alveolar spaces communicate with each other and contain the epithelial cells. These vary much in shape, size, and arrangement, but are always easily separable from the surrounding connective tissue, while they are never separated from one another by a stroma of any sort.

Clinical Characters.—Clinically, cancers are distinguished by the structures in which they originate; by the method of their recurrence and their mode of growth; as well as by a few characteristics apparent to the eye and touch.

Seat.—As their nature would *a priori* have rendered almost certain, cancers probably never originate except in connexion with epithelial or epidermic structures—*i.e.* in skin, mucous membrane, or secreting glands; but as the epidermis and epithelium, the original upper and lower layers of the embryo, are widely diffused throughout the body, and often intimately associated with the descendants of the cells of the middle layer, it is not surprising that primary cancers have been described as occurring in organs which have their origin from connective tissue only. Such are the instances of primary cancer of bone and lymphatic glands, the possibility of the occurrence of which may be at present considered undecided.

Recurrence.—The first recurrence is almost without exception in the lymphatic glands, which collect their supply of lymph from the seat of the original tumour; when this has occurred the process may be repeated in the next proximal lymphatic glands, or numerous distinct tumours may appear in different parts of the body; but if a single growth occur in another locality without previous glandular enlargement, the case may probably be looked upon as one of double primary development. A soft cancer may break into the abdominal cavity, where its small particles may stick to various parts of the peritoneum and form the starting-points of new-growths (disseminated cancer of the peritoneum); it is probable that a similar seeding may take place into the lungs when an ulcerated epithelioma projects into the trachea. The recurrence is usually of precisely the same structure as the original growth.

Mode of growth.—Cancers increase in size by infiltration of the surrounding tissues, and this gives rise to the very important clinical facts that they are not enclosed by a capsule like many simpler growths, and that they have a great tendency to implicate the skin and cause ulceration.

Naked-eye appearances.—The contraction of the connective tissue forming the alveoli in its advance towards fibrous tissue gives rise to puckering of the surrounding skin; and the looseness of the connexion between the epithelial and connective-tissue elements causes a milky juice consisting of the former to escape on scraping a recent section. This characteristic was made much of by our predecessors before the word *cancer* had lost its inclusive meaning; we know now that many rapidly growing *sarcomas* yield a similar juice, but in less abundance than cancers; and thus it has come to pass that a milky juice is now more diagnostic of the malignancy than of the genetic origin of the growth.

This completes the list of the signs by which cancers may be distinguished from other tumours. Tables have been published to show the relative frequency with which cancer attacks different organs; they are not, upon the whole, trustworthy, and this question will be best considered in discussing the subdivisions of the genus.

Classification. — The subdivisions of cancers are as follows:—

Hard cancer or *Scirrhus.*	GLANDULAR TYPE.
Soft cancer or *Encephaloid.*	
Lobular Epithelioma.	EPITHELIAL and EPIDERMIC TYPE.
Cylindrical Epithelioma.	
Colloid.	

Typical hard and soft cancers stand obviously at opposite ends of one series which is built upon the type of the secreting gland: between the two are an infinitude of intermediate stages. The two forms of epithelioma are, quite as evidently, monstrous growths of skin or mucous membrane. Colloid is probably the result of degeneration of any one of the other forms. Besides these, other varieties are often mentioned which do not justify a more complicated classification; amongst these are tumours, which though of nearly normal glandular structure are nevertheless malignant, and those which have received the names *melanotic*, *telangiectatic*, *osteocancer*, &c.

Diagnosis.—The diagnosis depends upon the clinical characters of the several groups. That of an advanced case of cancer is generally easy; in the early stages it is mostly impossible.

Prognosis.—The prognosis is always bad, especially in encephaloid cancer, but least so in epithelioma; this suggests the much-debated question of the constitutional nature of the disease. If in its origin a cancer be purely local, early removal ought to effect a permanent cure; but if there be at the bottom a constitutional taint, a reprieve should merely be granted until a suitable fresh irritation arise. There is probably some truth on both sides. The cancerous cachexia is often spoken of; it depends chiefly, if not altogether, on the weakening effects of the discharge after ulceration has taken place; mental worry may have some share in causing it; but it must be remembered that cancerous patients, who, before they are attacked, are frequently amongst the most robust, often retain their health for a remarkably long space of time.

Course.—The course of a cancer depends upon its seat, and the symptoms must accordingly be sought amongst the articles on diseases of special regions. If, however, life be not shortened as a result of interference with the functions of the organ attacked, death is caused either by marasmus—the result of prolonged suppuration and pain—or by extensive or repeated hæmorrhages. The rate of progress is more slow as age advances.

Treatment.—The treatment of cancer in the early stages belongs to the surgeon, the practitioner giving such counsel as will improve the general health and support the strength. In the later stages the physician may be called upon to treat symptoms; but up to the present time all the specifics introduced either by regular practitioners or by charlatans have proved quite inefficient, if not actually harmful.

We shall now discuss the varieties of cancer.

I. **Scirrhus.**—Scirrhus, as its name implies, is amongst the hardest of tumours, if bony growths be excepted. Its hardness, as compared with soft cancer, depends upon the larger proportion which the alveolar stroma bears to the contained cells; and this is probably the consequence of the soil in which the tumours originate, and the rapidity of their growth, rather than of any specific difference between them.

Seat.—The female breast is the most common seat for scirrhus, but it also occurs in the stomach, uterus, tongue, œsophagus, and the liver and other glands, and it has been described as primary in the prostate, testicle, skin, and other structures.

Naked-eye appearances.—A section through the centre of a matured hard cancer of the breast presents to the naked eye well-marked and constant appearances, which, with the exception of such peculiarities as are due to the situation, will serve as a description of such a tumour occurring elsewhere. These are clearly explained by the microscopical arrangement, and when looked at by the light which it affords, fully account for all the clinical characters. The knife passes through it with a creaking noise, and the cut surfaces are at once hollowed in the centre. There is not a sharp edge to the growth, and the circumference is of a greyish or pinkish-white tint, projecting a little above the surrounding tissues, into which it sends small lobular prolongations; the hollow centre is very hard and of a glistening white colour. Scirrhus is evidently fibrous in structure, and receives from all quarters fibrous bands, which often pass far out into the fat of the breast or the skin, and some of which can nearly always be traced to the principal milk-ducts. Between the centre and the edge the greater part of the tumour is on the whole of a pinkish-yellow colour, but notably pink and soft externally, and yellow and hard internally. The surface yields a milky juice on scraping, and may show some of the following appearances, which are, however, accidental: round the circumference little masses of healthy fat may be included, though this but rarely happens; cysts containing grumous grey or red fluid may have formed by the breaking down of the new-growth or by hæmorrhage; or such a hæmorrhage may have resulted in patches of yellow or even black pigmentation.

Microscopical appearances.—Without discussing the merits of the opposing theories as to the origin of cancer-cells, the following may be taken as the undoubted microscopical appearances of scirrhus. The grey outer layer is made up of indefinite smallish round cells, resembling white blood-corpuscles, infiltrated through the tissue into which the growth is spreading, amongst which are scattered a few which have the appearance of epithelial cells. The next or pink layer represents full development and shows fibro-cellular stroma, enclosing large epithelioid cells, and containing a copious supply of vessels. In the third or yellow layer the stroma has become fibrous, and the cells are undergoing fatty degeneration; and in the inner white centre the cells are replaced by indefinite masses of granular débris, and the stroma consists of firm and old fibrous tissue. *See* Plate, figs. 14, 16, and 17.

Clinical features.—The relation of these appearances to the clinical peculiarities of scirrhus is as follows: the excessive hardness is explained by the great development of fibrous tissue; the peculiar indefiniteness of the edge, and the tendency to involve the skin and ulcerate, by the manner of growth; while the puckering, retraction of the nipple, and indirectly (from the manner in which cutaneous nerves are involved) the pricking and shooting pains, are due to the contraction or cicatrisation of the stroma. To the latter is also due a very important but not generally recognised diagnostic character of an early scirrhus, namely, that long before the skin is involved it is seen to be dimpled when gently moved to and fro over the growth.

A scirrhus which has involved the skin forms a purplish-red, flattened, and shining tumour, covered with small veins and tender to the touch. The ulcer which results from its breaking down is ragged, with a hard base and hard irregular undermined edges, and a dirty surface covered by knobby masses of pseudo-granulations, which have a great tendency to bleed, and often slough. After removal it often returns in the scar. When occurring in the liver it is softer than elsewhere, and the name of scirrho-encephaloid is often given to it. *See* fig. 13.

II. **Encephaloid.**—Encephaloid, medullary, or soft cancer, so named from its usually brain-like appearance and consistence, is softer and grows more rapidly, and is more frequently observed in internal organs than scirrhus, often indeed forming enormous intra-abdominal tumours.

Seat.—It has hitherto been observed as primary in the salivary and mammary glands, testicle, ovary, and prostate, the thyroid body, and in the mucous membrane of the nose, the liver, and the stomach. It has with some degree of looseness been called the cancer of childhood by those who consider scirrhus as almost peculiar to mature age.

Naked-eye appearances.—To the naked eye a fresh section usually presents a convex surface; it is whitish, but generally mottled by coloured patches, the result of old or recent hæmorrhages; and yields very copiously a milky juice on scraping.

Microscopical appearances.—Encephaloid cancer differs from scirrhus only in the relative proportion of the two chief factors. The cells are more numerous and are contained in larger spaces; they are sometimes small, but generally much larger than in scirrhus; and the stroma is delicate and fibro-cellular and very small in amount. *See* fig. 15.

Its method of extension is the same as that of other members of the class. It is by far the most malignant form of cancer, because of its rate of growth and recurrence, and the rapidity with which it causes general cachexia.

III. **Lobular Epithelioma.**—Lobular epithelioma, epithelial cancer, or cancroid, develops in connexion with skin and mucous membrane, and though consisting essentially of squamous epithelium, may start from a part which is covered by the cylindrical variety. It occurs near the natural orifices of the mucous tracts—as, for example, on the mouth and tongue, anus, penis, or vulva; but also at other parts of the skin—as on the scrotum (chimney-sweep's cancer) and at the upper end of the œsophagus. The history of a local irritation as its origin is often obtainable, but more frequently nothing of the kind can be discovered.

Naked-eye appearances.—The first appearance is that of a pimple, which soon breaks down in the centre, forming a small sore. When fully developed there is an irregular ulcer, with an extensive, hard and nodular, generally inflamed base and circumference; the edges are abrupt or undermined, and the floor grey or reddish, very uneven, discharging a foul pus, and with a great tendency to bleed. As a rule there is considerable pain, and the proximal lymphatic glands are very generally enlarged. A section to the naked eye shows a number of minute cylinders of yellowish-white colour, cut sometimes longitudinally, sometimes transversely, fusing together into an indefinite mass superficially, but more or less discrete below, and infiltrating amongst the subjacent tissues. On squeezing the section little nodules like sebum appear on the surface.

Microscopical appearances.—The cylinders or lobes of epithelioma are found to be made up of squamous epithelium, the cells of which generally exhibit in parts a crenated margin (Max Schultze's spine-cells). As in the skin, the deeper—that is the circumferential—layer of cells in each lobe, which are the youngest, are roundish or oblong, with large nuclei which stain readily; further in, the cells are larger and flatter, and in the centre are found the well-known globes or nests. These were at one time considered peculiar to epithelioma, but are now known to occur in warts and corns; they consist of onion-like arrangements of epithelial cells, varying much in size and the number of concentric layers, and containing in the centre sometimes an amorphous mass, sometimes large and irregular cells. The tissues beneath and between the lobules are infiltrated with small cells, and often contain in sections what appear to be isolated masses of epithelium; these are, however, the ends of divided divergent lobules. Opinions differ as to the exact starting-point of an epithelioma, the share which the sweat- and other glands take in it, and also as to the rationale of the formation of the globes. *See* fig. 8.

Epithelioma seems to be more local in its nature than other cancers—that is, a complete and early removal has not infrequently given the patient a long lease of life. It recurs, as a rule, in the lymphatic glands (which inflame and break down or suppurate) or in the scar; and generally proves fatal from the constitutional disturbance which these local manifestations give rise to. Later, but more rarely, it may appear in the internal viscera, bones, &c.

IV. **Cylindrical Epithelioma.** — The cylindrical epithelioma—badly named adenoid or glandular cancer—is specially the cancer of the alimentary mucous membrane, but may occur in the bladder and elsewhere.

Naked-eye appearances.—To the naked eye it forms at first a prominent tumour in the interior of a viscus, which has a tendency, like other cancers, to ulcerate and involve surrounding tissues, so that the mass may reach an enormous size, and may even make its appearance through the skin. To the naked eye a section is generally whitish and has a granular appearance, which is given to it by the tubules of which it is made. It frequently causes death by obstruction of the bowel; but if it last sufficiently long, it recurs in the lymphatic glands, and then in the viscera and other parts of the body. It is not unfrequent to find recurrences in the liver with little if any implication of lymphatic glands. The recurrence reproduces precisely the structure of the original tumour.

Microscopical appearances. — Cylindrical epithelioma consists essentially of irregular

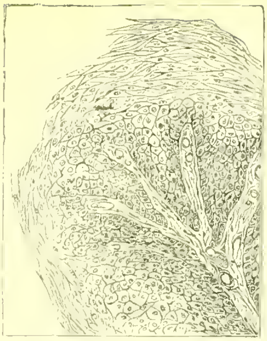

Fig. 7. Papilloma of Soft Palate.

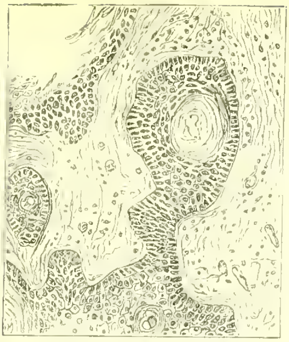

Fig. 8. Epithelioma of Lip.

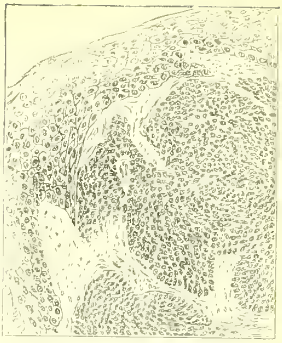

Fig. 9. Edge of Rodent Ulcer.

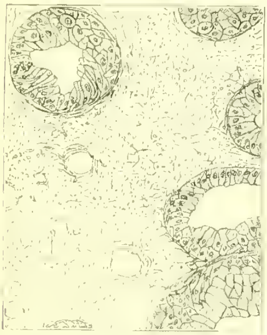

Fig. 10. Simple Polypus of Rectum.

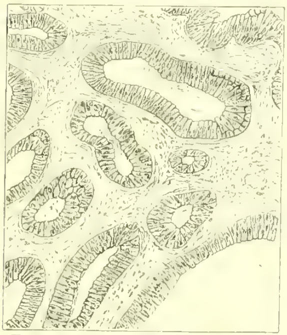

Fig. 11. Columnar Epithelioma of Intestine.

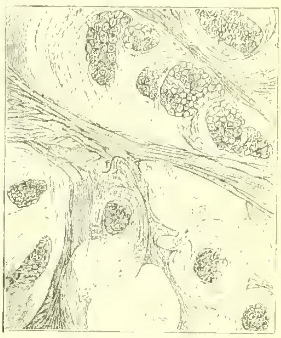

Fig. 12. Colloid of Breast.

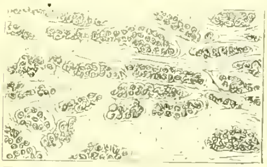

Fig. 13. Cancer of Liver (Scirrho encephaloid).

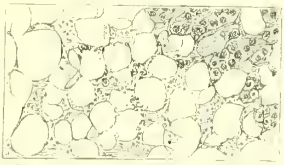

Fig. 14. Scirrhus infiltrating Fat.

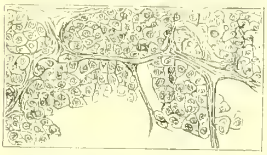

Fig. 15. Encephaloid Cancer.

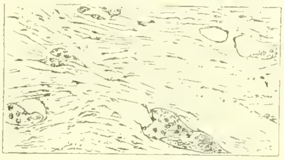

Fig. 16. Cicatrising Cancer.

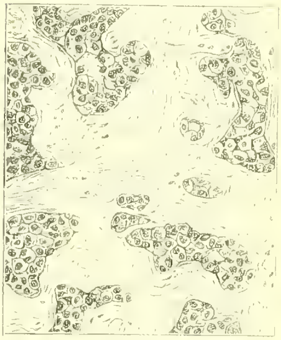

Fig. 17 Scirrhus of Mamma.

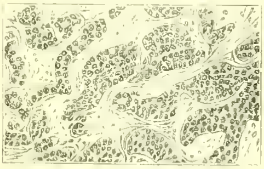

Fig. 18. Adenoid of Upper Jaw (Benign).

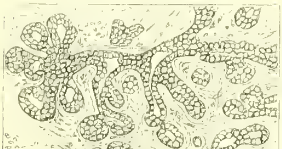

Fig. 19. Adenoid of Breast (common type).

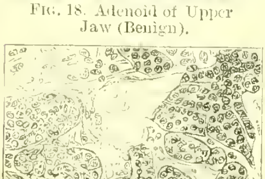

Fig. 20. Ulcerated Adenoid of Parotid (Malignant).

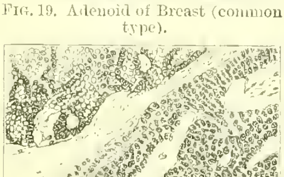

Fig. 21. Adenoid of Breast (epithelial element in excess).

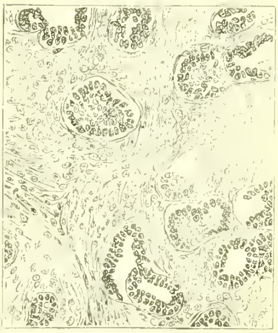

Fig. 22. Adenoid of Breast (Adeno-sarcoma).

Drawings illustrating a Series of Tumours of the Epithelial Type.
All drawn to the same scale (× 87 diameters).

tubules lined with columnar epithelium in one or more layers, which are the much overgrown crypts of Lieberkühn, and differs in microscopical structure from simple papilloma of the digestive tract only in the greater irregularity of the cells and in the larger proportion of connective-tissue stroma between the tubes. Compare figs. **10** and **11.**

V. **Colloid.**—Colloid, or alveolar cancer, named from its jelly-like appearance, has given rise to much discussion in reference to the question whether it is developed originally in its mature form, or whether it results from the degeneration of one of the varieties of cancer already described. The latter view is that most widely held, though it must be allowed that epithelioma seldom degenerates in this way, and also that the colloid change usually takes place *pari passu* with the growth of the tumour.

Seat.—Colloid cancer is found most frequently in the abdominal viscera and peritoneum, but may occur elsewhere, as in the breast. Its malignancy is great, but is shown chiefly by the rapidity with which it involves surrounding tissues; it thus forms primary tumours of enormous size, but as a secondary growth is less common; it does, however, occur in lymphatic glands and other parts. It causes death in most cases by interference with the functions of the organs attacked.

Naked-eye appearances.—Colloid cancer consists to the naked eye of a mass of semi-transparent jelly, varying slightly in colour, but mostly pale yellow: this is intersected by delicate white fibrous bands, forming alveolar spaces of different sizes, visible to the naked eye. The consistence of the growth depends upon the relative proportions of these two constituents.

Microscopical appearances.—The bands are found to be actually fibrous; the contained jelly is arranged in concentric laminæ between which are minute granules, and in the centre of which is a granular mass, sometimes quite indefinite, but often showing clearly that it consists of the remains of altered cells. These cells are seen in the more recent parts of the growth to be the subjects of colloid degeneration. The source of the colloid material must be considered still undecided; that some of it is formed by the cells is certain, but it is not equally clear whether the stroma takes any share in its deposition. *See* fig. 12.

Conclusion.—Our knowledge of the pathology of new-growths is undergoing a process of evolution, not now, however, so rapid as in recent years. Not much therefore has required alteration since this article was written nearly ten years ago, and it is hoped that it will still be found fairly to represent the opinions most widely accepted at the present day.

R. J. Godlee.

CANCRUM ORIS (*cancrum*, a sore; and *oris*, of the mouth).—Synon.: Gangrenous Stomatitis; Noma; Water-canker; Fr. *Nome*; Ger. *Wasserkrebs.*

Definition.—A rapidly progressive gangrenous ulceration of the cheek, gum, and lip.

Ætiology.—Cancrum oris is usually seen in ill-fed, ill-tended children, living under the most faulty hygienic circumstances. It frequently ensues upon some acute depressing illness, especially measles (110 times in 226 cases—Sannée). Occasionally two or three cases occur together in a school, suggesting the possibility of contagion. Lingard has demonstrated long threads of small bacilli in the spreading edge of noma in man, and in a similar disease of calves; and inoculation on calves of a pure culture from man induced the disease.

Symptoms.—Cancrum oris commences on the inner surface of the cheek, often near the angle of the mouth, or upon the gum; and at this stage some superficial ulceration will usually be found here—that is, ulcerative stomatitis. The disease rapidly advances. The cheek becomes much swollen, brawny, shining, and red; a livid spot appears in the centre, and here a spreading black slough forms, while the surrounding parts become purplish or mottled. If the patient can open his mouth sufficiently, the gums will be seen to be red and spongy, ulcerating, or destroyed; even the tongue may show some ulceration. The cheek is lined with a tough, adherent, greyish-yellow or soft purplish slough; the jaw may be laid bare, the teeth loosened, and portions of the alveolus necrosed. The breath is very foul, and the flow of saliva is excessive and fœtid. Fever may be moderate or high. Pain is slight or absent, and the child, though lethargic, is conscious almost to the end. Not more than one in twenty cases recovers, death being generally due to septic broncho-pneumonia.

Diagnosis.—Formerly mercurial stomatitis sometimes ran on to gangrene in debilitated patients; this inflammation was general, and affected the tongue markedly. No hard line can be drawn between ulcerative stomatitis and noma.

Treatment.—This consists in complete and careful excision by knife and sharp spoon of the diseased area, regardless of the deformity which must result. To parts which cannot be excised, nitric or pure carbolic acid should be freely applied. Iodoform gauze is the best dressing. The mouth must be frequently and carefully syringed and sponged out with an antiseptic lotion, especially before food is taken. As far as possible, the child should lie so that foul saliva, &c. may dribble from the mouth and not down the throat. Dr. Goodhart thinks that even tracheotomy might be done to prevent inhalation of septic material into the lungs. Fluid food, especially pancreatised beef-tea or milk-gruel, should be given regularly and frequently, by mouth, nasal tube, or encmata. Ammonia and bark or other tonics should be exhibited.

W. Fairlie Clarke. Stanley Boyd.

CANITIES (*canus*, hoary or greyhaired). Whiteness or greyness of the hair. *See* Hair, Diseases of.

CANNES, in France, on the Mediterranean coast. A dry, bracing, fairly mild winter climate. Exposed to N.W. Abundant accommodation, both near and at some distance from the sea. *See* Climate, Treatment of Disease by.

CANTHARIDES, Poisoning by.—Synon.: Fr. *Empoisonnement par la Cantharide*; Ger. *Cantharidenvergiftung.*

Cantharides, the so-called Spanish Fly, owes its poisonous properties to the presence of *cantharidin*, a non-alkaloidal body. All the preparations of the drug are highly poisonous.

Symptoms.—Soon after taking a poisonous dose of cantharides, the patient is seized with burning pain in the pharynx, and a sense of constriction in the œsophagus. The pain soon extends to the abdomen, and vomiting ensues; the abdominal pain becomes aggravated; and usually purging sets in. The stools are numerous, often scanty, passed with great pain and straining; they are at first mucous, and finally' bloody. If carefully examined, little iridescent specks—portions of the elytra of the beetle—may be observed in the fæces and vomited matters. These are of course only observable when the powdered insect has been taken; and they frequently escape observation. Up to this period of the case, should portions of the beetle not have been detected, there is nothing to distinguish the case from one of ordinary irritant poisoning; except, perhaps, that salivation and swelling of the salivary glands are usually prominent symptoms. The gastro-intestinal inflammation may be so intensely and rapidly developed, that death may occur from collapse before strangury, the diagnostic symptom, is set up. Generally, however, the course is somewhat different, genito-urinary irritation and inflammation setting in; the symptoms of which are aching pains in the lumbar region, frequent desire to micturate, with violent tenesmus of the bladder, till eventually a few drops of albuminous or bloody urine only can be passed, or none at all. Priapism, erotic excitement, and swelling of the genitals are of frequent, though not of constant, occurrence. Delirium, tetanic convulsions, or paraplegia, may be noted in some cases. Eventually the intolerable agony gives way to collapse, stupor, coma, and death. Abortion not infrequently occurs in pregnant women, the drug being formerly much used as an abortifacient.

Diagnosis.—The intense strangury, the swelling of the genitals, and the bloody stools, will leave little or no doubt as to the nature of the case; and the presence of particles of the drug in the ejecta will be conclusive.

Fatal dose.—Less than half a drachm of the powder, and an ounce of the tincture, have alike proved fatal.

Treatment.—Evacuation of the stomach by the use of the stomach-pump, syphon-tube, or an emetic is the first indication in poisoning by cantharides. It is best to thoroughly wash out the stomach. Mucilaginous drinks, white of egg (not the yolk), and demulcents, may be freely given; but oil in any form is to be avoided, as tending to dissolve cantharidin. Opium by the mouth or rectum, or the hypodermic injection of one-third of a grain of morphine, is advisable. Leeches to the region of the bladder, warm fomentations, and warm sitz-baths may afford relief. Chloral should also be given, or the patient kept cautiously under the influence of chloroform. Collapse may be met by ammonia and other stimulants. The hypodermic injection of a few drops of ether is useful. There is no known antidote for cantharidin. Thomas Stevenson.

CAPE COLONY, in South Africa. *See* Africa, South.

CAPE OF GOOD HOPE.—A warm, generally dry climate, but very variable, and liable to sudden storms. *See* Africa, South; and Climate, Treatment of Disease by.

CAPILLARIES, Diseases of.—Synon.: Fr. *Maladies de Vaisseaux Capillaires*; Ger. *Krankheiten der Capillargefässen.*—The morbid conditions of the capillaries may be described in the following order:—1. Fatty Degeneration. 2. Calcareous Degeneration. 3. Albuminoid Degeneration. 4. Pigmentation. 5. Changes in Inflammation. 6. Dilatation. 7. Narrowing and Obliteration. 8. Thrombosis. 9. Embolism. 10. Rupture. 11. The New Formation of Capillaries. 12. Capillaries in New-Growths and Tubercle. 13. Changes in the Perivascular Space and Sheath. 14. Teleangiectasis.

1. Fatty Degeneration.—This is the most common disease of the capillary-wall, and is frequently associated with fatty degeneration of the surrounding tissues. The cause of this change in the protoplasm of the capillary is, as elsewhere, interference with nutrition, and especially with oxidation. It is accordingly found in morbid conditions of the blood; in interference with the blood-supply; and in lesions of the nervous system. The microscopical characters of the early stages of fatty degeneration when it affects the capillaries are not peculiar; in advanced stages the diseased vessels may present the appearance of opaque granular cords; and the lymphatic sheaths of the cerebral capillaries are sometimes found, under such circumstances, filled with oil-globules and fatty cells. A frequent termination of the disease is rupture and hæmorrhage. Fatty degeneration of the capillaries occurs most frequently in the nervous centres, where it can be readily demonstrated, in the kidneys, in certain tumours, and in the products of infarction and inflammation.

2. **Calcareous Degeneration.** — This disease is rare in capillaries.

3. **Albuminoid Degeneration.**—Albuminoid degeneration affects the Malpighian glomeruli in the early stage of this affection of the kidneys. In other parts of the body the capillaries are less subject to albuminoid change than the small arteries.

4. **Pigmentation.**—Pigmentary granules may sometimes be found in the walls of capillaries, but they more frequently occupy the perivascular space. In either situation pigmentation is the result of chronic congestion or inflammation, or of hæmorrhage.

5. **Changes in Inflammation.**—The changes of the capillaries of an inflamed part constitute an important factor of the process of inflammation. *See* INFLAMMATION.

6. **Dilatation.**—Dilatation of capillaries, which is one of the changes in passive venous congestion and inflammation, may become permanent if the cause persist.

Changes in the nutrition of the capillary-wall, combined with disturbances of the circulation, such as increased pressure, produce local dilatation or **Aneurysm** of the vessels, and subsequent rupture. This is one form of *miliary aneurysm* as it occurs in the brain. *See* BRAIN, Vessels of, Diseases of.

7. **Narrowing and Obliteration.**—Narrowing of capillaries may be temporary, as in inflammation; or permanent, from external pressure, or from interference with the blood-supply. Narrowing may proceed to complete obliteration.

8. **Thrombosis.**—Thrombosis rarely occurs in capillaries. *See* THROMBOSIS.

9. **Embolism.**—The phenomena of ordinary embolism in a great measure affect the capillaries corresponding with the obstructed artery. But, besides this change, capillaries are themselves subject to embolism, or impaction of particles within them. The products of inflammation or degeneration, pigment-particles, oil or fat-drops from the marrow of fractured bones, organisms, and various substances artificially introduced into the circulation, have been discovered obstructing the capillaries in different instances. All the possible results of embolism in large vessels may follow, according to circumstances, but anastomosis being very free, they are comparatively insignificant functionally, unless the obstruction be extensive; and in the case of the cerebral vessels definite symptoms are believed by some to result, such as delirium and choreic movements. *See* CHOREA.

10. **Rupture.**—Three circumstances specially determine the occurrence of this lesion of capillaries, namely, disease of the vessel-wall, increase of the blood-pressure, and a 'terminal' distribution of the branches of the artery that supplies them. The most common diseases of the wall are fatty degeneration and aneurysm. The blood-pressure rises within the capillaries of any part in ventricular hypertrophy, in increased tension of the arteries of other parts, and in venous obstruction. When an artery is 'terminal,' that is, unprovided with other anastomoses than through its capillaries, no lateral relief can be afforded in sudden and excessive rises in the force of the circulation. For these several reasons, rupture of capillaries is most frequent when the vessel-walls have been weakened in the fatty degeneration of senile decay, in septicæmia, inflammation, purpura, fever, and scurvy; in chronic Bright's disease with increased blood-pressure; and in such organs as the corpus striatum, retina, spleen, kidney, villi, and skin. Disturbances in the pressure of the air within the chest powerfully influence the occurrence of capillary-rupture in the respiratory tract. When a capillary-wall gives way, the blood is extravasated either on a free surface, constituting hæmorrhage; into the substance of the tissues around; or along the lymphatic sheath of the ruptured vessel, where it gives rise to the appearance that has been described by some authorities as *dissecting capillary aneurysm*.

11. **New Formation of Capillaries.** Capillaries grow or develop in nearly all forms of new-growths, whether inflammatory or otherwise. The young capillaries are derived either from cellular buds upon previous capillaries, which become hollowed by the blood-pressure; from anastomosing exudation cells, or connective-tissue corpuscles; or, in some cases, from the parallel disposition of exudation-cells.

12. **Capillaries in New-Growths and Tubercle.**—The capillary-walls are believed to play an important part in the production of certain forms of new-growths. *See* TUMOURS; and TUBERCLE.

13. **Changes in the Perivascular Space and Sheath.**—The perivascular or lymphatic sheath, which probably envelops all capillaries, is liable to certain morbid conditions, which are chiefly secondary to changes in the vessel within it. Thus the space may become filled with blood from escape of the corpuscles by rupture or otherwise; with leucocytes in inflammation; with oil-globules and fatty corpuscles in degeneration of the wall; with pigment-particles; or with serum in disturbances of the circulation. The calibre of the perivascular canal, which varies inversely with that of the contained capillary,

may thus be increased, and present uniform or irregular dilatation.

Changes in the *outer* sheath, or wall of the lymphatic space, have also been observed, including fatty degeneration of the lining cells, and hyaline thickening.

14. **Teleangiectasis.**—At least one form of vascular tumour consists of a local overgrowth of capillaries, which are both enlarged and multiplied. *See* TUMOURS.

J. MITCHELL BRUCE.

CAPILLARY BRONCHITIS.—Inflammation involving the minute bronchial tubes. *See* BRONCHI, Diseases of.

CARBOLIC ACID, Poisoning by. *See* POISONS.

CARBONIC ACID, Poisoning by. The inhalation of carbonic acid causes injurious or fatal results, according to the length of time and degree of concentration. Carbonic acid accumulates in large quantities, almost undiluted, in pits, cellars, wells, mines (especially after explosions, constituting what is called choke-damp), volcanic grottoes, fermenting vats, lime-kilns, &c. A continuous contamination of the atmospheric air with carbonic acid goes on from the respiration of animals and the combustion of fuel. The generation of CO_2 by a human being averages about 0·6 cubic foot per hour; that of an ordinary gas-burner 2· cubic feet of CO_2 for every one of gas burnt; that of an oil lamp relatively more. The gradual exhaustion of oxygen and proportionate accumulation of carbonic acid in ill-ventilated apartments is one of the factors of the evil results of bad ventilation, but not the only one, as other animal exhalations contribute largely to the result.

As a rule excess of carbonic acid means corresponding deficiency of oxygen in the atmosphere, and the proportion cannot exceed 10 per cent. without rapidly fatal results ensuing; but much less than this causes injurious, and even fatal consequences if long inhaled; and less than 2 per cent. cannot be breathed for any length of time with impunity.

If the amount of oxygen be not correspondingly diminished, carbonic acid if present in sufficient quantity in the atmosphere respired will still act fatally. Thus Bernard found that a bird died instantaneously in an atmosphere of equal parts of oxygen and carbonic acid; and Snow found that 20 per cent. of carbonic acid in an atmosphere containing the normal proportion of oxygen soon proved fatal to small animals, and that even 12 per cent. might cause death after a longer interval.

SYMPTOMS.—Undiluted carbonic acid is not readily inhaled, as it tends to induce spasm of the glottis, but immersion in such an atmosphere is rapidly fatal. It seems to act as a narcotic. The patient falls down prostrate and insensible, and death occurs almost immediately. This effect is seen occasionally when labourers incautiously descend an old well, or when miners enter a region filled with choke-damp. Not infrequently several fall victims, as one goes to see what has happened to the other and meets the same fate.

When the carbonic acid is more diluted, the symptoms are headache, giddiness, and sense of oppression, followed by drowsiness, and singing in the ears. Ultimately a condition of insensibility ensues, with stertorous breathing and muscular prostration; death usually occurring quietly and without convulsions. If the excess of carbonic acid corresponds with deficiency of oxygen, we have in addition to the essentially narcotic effects of carbonic acid, the dyspnœa and other symptoms of asphyxia. *See* ASPHYXIA.

POST-MORTEM APPEARANCES.—These are largely those of asphyxia, namely, a general engorgement of the venous system. This is generally seen in the brain more frequently than in asphyxia pure and simple. The blood is dark and fluid. The hæmoglobin is completely reduced. Animal heat is said to be retained long after death, and rigidity is well-marked and enduring.

PATHOLOGY.—As has been already said, carbonic acid does not act merely as a negative asphyxiant by taking the place of oxygen, but has a distinctly toxic narcotic effect. Very frequently in cases of poisoning by carbonic acid there is a combination of asphyxia, essentially due to deficiency of oxygen, with the narcotic symptoms due to carbonic acid.

TREATMENT.—1. *Prophylactic.*—Caution should be exercised in exploring wells, mines, &c., where there is any likelihood of the accumulation of carbonic acid. The introduction of a lighted candle is a rough and ready test of considerable value. The mere fact of a candle continuing to burn in an atmosphere is no test of its being respirable with impunity, for a candle will burn in an atmosphere containing 10 per cent. of carbonic acid if the oxygen is present in the normal amount, and the presence of an amount of carbonic oxide sufficient to cause death will not materially affect the flame. If carbonic acid reaches the proportion of 16 per cent. the candle will, however, be extinguished. If a candle is extinguished, then certainly the atmosphere cannot be breathed, and therefore the test is of sound practical value. If carbonic acid is present, it should be expelled by creating a draught of some kind. Thus wells may be swept by some such contrivance as an inverted umbrella, and a stream of air or steam can be directed into enclosed spaces.

2. *Restorative.*—Artificial respiration and its various accessories are needed to restore a person actually in a state of coma from carbonic acid. This treatment, of course, is subsequent to instant removal from the impure atmosphere. Pure oxygen should also be administered if at hand. *See* ARTIFICIAL RESPIRATION; and RESUSCITATION. D. FERRIER.

CARBONIC OXIDE, Poisoning by. Carbonic oxide is a much more dangerous agent than carbonic acid, and to it are due many of the effects sometimes ascribed to the latter. Pure carbonic oxide is rarely generated out of the chemical laboratory, but mixed with other gases carbonic oxide is not uncommon. This is especially the case in the fumes of burning charcoal. The carbonic acid of the burning charcoal while passing over the heated embers loses an atom of oxygen, or takes up an atom of carbon, and is converted into carbonic oxide, which burns with a bluish flame at the top. The toxic action of charcoal vapours is essentially dependent on the carbonic oxide they contain. Usually charcoal fumes contain from 2 to 3 per cent. of carbonic oxide, to 25 of carbonic acid, along with some heavy carburetted hydrogen. The vapours, however, are still as effective after being passed through lime-water, which fixes the carbonic acid. Poisoning by charcoal vapour is not an uncommon form of suicide, more particularly abroad, and many cases have occurred accidentally in this country, from sleeping in rooms in which there was no flue for the escape of the fumes of burning charcoal, or into which there has been leakage from stove pipes, &c. Carbonic oxide is always found in the air of rooms where cast-iron stoves are used, from some of the carbon of the cast iron itself being formed into CO, and the iron when heated allowing a large quantity to pass through the metal.

Carbonic oxide also exists in coal gas, and in still larger quantities (44 per cent.) in the new water-gas, constituting their main danger. It is likewise found in the emanations from brick-kilns.

Carbonic oxide is an extremely active poison. Letheby found that ·5 per cent. of carbonic oxide in the respiratory medium killed small birds in three minutes, and that 2 per cent. killed a guinea-pig in two minutes. Many similar experiments have been performed with similar results. The animals soon become insensible, and die generally without exhibiting convulsive phenomena beyond a few tremors or flutterings.

Symptoms.—In man inhalation of carbonic oxide for a short time, as Sir H. Davy and others have proved on themselves, causes headache, pulsation in the temples, giddiness, nausea, and great prostration, tending to drowsiness and insensibility. Continued inhalation causes profound coma. Usually death occurs quietly, but signs of vomiting are frequently observed near those who have been poisoned by charcoal fumes.

Post-mortem Appearances.—The specially characteristic appearance of death from carbonic oxide is the cherry-red colour of the blood and internal organs. The post-mortem hypostasis exhibits a similar bright red tint. Frequently in those poisoned with carbonic oxide the face retains a ruddy hue. The red tint of the blood is due to the compound which carbonic oxide forms with hæmoglobin. Carbonic oxide displaces the oxygen and forms a very stable compound with the hæmoglobin, not readily broken up, and hence the oxygen-carrying power of the corpuscles is paralysed.

In the spectroscope carbonic-oxide blood exhibits two absorption-bands very similar to those of ordinary blood-colouring matter or oxyhæmoglobin, but a difference in the exact breadth and position of the bands can be made out by means of the microspectroscope, when the two are compared together. Carbonic-oxide-hæmoglobin resists reduction in the usual manner, and here again differs from normal blood-colouring matter. Hoppe-Seyler gives as an additional test the action of caustic potash on carbonic-oxide- and ordinary hæmoglobin respectively. With the latter it causes a green colour on a porcelain plate, while with the former the colour continues red.

Pathology.—Carbonic oxide acts by paralysing the blood-corpuscles, as Bernard expresses it, and rendering them unable to take up oxygen. Hence internal respiration is prevented, and death ensues from asphyxia.

Treatment. — As carbonic-oxide-hæmoglobin is a very stable compound, and offers a very considerable resistance to displacement by oxygen, though not absolute as was at one time considered, artificial respiration is not likely to be successful by itself. The best treatment is venesection and transfusion of fresh blood. This method of treatment has proved successful in one or two instances in which it has been employed.

D. Ferrier.

CARBUNCLE (*carbunculus*, a small coal—*carbo*).—Synon.: Anthrax; Fr. *Anthrax*; Ger. *Karbunkel.*

Definition.—A specific local inflammation of the subcutaneous areolar tissue, rapidly leading to sloughing of the deeper and more central parts, followed by destruction of the skin; the whole of the dead tissues finally separating in the form of a slough.

Ætiology.—Carbuncle is a constitutional affection, dependent upon conditions of general debility or of plethora, and often associated with gouty or diabetic tendencies. It is more commonly seen in men than in women; is rarely met with under the age of twenty; and it attacks all ranks of life.

Symptoms.—The most common seat of carbuncle is the back of the trunk or neck, but it may occasionally be found in other situations. The affection usually begins as a painful, hard, slightly elevated, and ill-defined swelling, which gradually increases in extent and assumes a dusky red tint. A vesicle containing bloody serum soon forms over the most prominent part, and on rupturing discloses several small apertures in the subjacent skin, which give exit to a glutinous purulent discharge. This sieve-like condition of the undermined integument often persists throughout the course of the disease. Occasionally, however, owing to the destruction of the intervening skin, the several apertures merge into a single, large, ragged opening, and thus expose the characteristic ash-grey, slimy slough, which separates slowly by suppuration, leaving an irregular cavity with deeply undermined edges. The cicatrix left after healing is usually uneven and may be permanently discoloured.

In the early stage of the disease, while the inflammatory œdema is still extending, the patient generally complains of a burning, throbbing sensation in the part, which may become intensely painful; but on the full exposure of the slough, the pain diminishes, and in the later stages it may cease entirely.

When the carbuncle is large, or involves a portion of the scalp, there is usually considerable constitutional disturbance of an asthenic type. Death may then occur from exhaustion, which is sometimes aggravated by free hæmorrhage resulting from incisions; but the most frequent cause of a fatal termination is pyæmia.

Diagnosis. — Carbuncle is distinguished from boil by the size and extent of the swelling, and by its tendency to spread; by the livid tint of the skin, and the early formation in it of more than one aperture; by the character of the slough, by the severity of the pain, and the marked constitutional disturbance; and, finally, by the fact that carbuncle, unlike boil, usually occurs singly.

Prognosis.—This will depend chiefly upon the age of the patient, and upon the seat and extent of the disease, which proves most dangerous to life when situated or encroaching on the scalp, especially in a person over fifty. The coexistence of albuminuria or chronic saccharine diabetes is always a grave complication.

Treatment.—The *constitutional* treatment and the management of patients with carbuncle are best conducted on general principles. In ordinary cases the diet should be of good quality and sufficient in quantity, with a moderate allowance of stimulants, proportionate to previous habits. Should the patient's strength and the situation of the carbuncle allow him to move about, he need not be confined to his room, and may even be allowed exercise in the open air.

In the more severe forms of the disease, the frequent administration of dietetic stimulants and good nourishment in an easily assimilable form is usually necessary. The bowels, if they require it, should be cleared out by some non-irritating aperient, and the patient put on a course of quinine or bark and the mineral acids. Opium or other sedatives may be required in the earlier stages to relieve the intense sufferings of some patients; while in the after-course of the disease, it may be sometimes needed to procure sleep.

For *local* treatment *see* Boils.

For *carbuncle of the face*, an affection distinct from the Malignant Pustule described by Continental surgeons, *see* Pustule, Malignant; and Boils.

William A. Meredith.

CARCINOMA. *See* Cancer.

CARDIAC DISEASES. *See* Heart, Diseases of.

CARDIALGIA (καρδία, the heart; and ἄλγος, pain).—A synonym for heartburn, originating in a popular impression that this painful sensation, which starts from the epigastrium, is connected with the heart. *See* Heartburn.

CARDIOGRAPH, The (καρδία, the heart; and γράφω, I write).—This is an instrument for registering graphically the form of the heart's movements. It really records a tracing of the cardiac impulse, the curves of the trace representing the changes of pressure exerted by the apex of the heart on the chest-wall. We owe the invention of the cardiograph to Marey, who, in his physiological researches on the circulation of the blood, obtained by the following means the form of movement of each cavity of the heart. He introduced into the auricles and ventricles of a horse, hollow sounds terminating in elastic ampullæ filled with air. The air communicated through the sounds and elastic tubes with terminal ampullæ, or tympana covered with elastic membrane, on each of which rested a light lever. The movements communicated by the heart to the closed column of air were amplified by the levers and recorded by them on a revolving cylinder. In this way tracings of the forms of movement of each cavity were obtained, and by comparison with a tracing taken simultaneously of the exposed apex-movement, an explanation of the complex apex-tracing was rendered possible. The cardiograph used for clinical research is a modification of the above, and consists of a hollow cup containing a small spring which can be depressed by means of a screw so as to rest firmly on the chest-wall where the impulse is felt. The cup communicates by means of an elastic tube with a tympanum covered with elastic membrane, carrying on its surface a lever. When applied to the chest the cup hermetically seals the air column, which transmits as waves the motion received by the spring to the lever resting on the tympanum. The movements are recorded by the end of the lever, either on the plate of a sphygmograph or on a revolving cylinder.

By means of this apparatus a very perfect representation of the cardiac movements can be obtained, the auricular and ventricular elements traced, and the duration of each measured. The transmission of the motion through an elastic medium like air has been objected to, as liable to modify the tracing by (1) the production of secondary oscillations in the air column; and by (2) gradual change in the form of motion caused by the elasticity of the medium. Practically, however, these objections are not valid, as is shown by the fact that the last of a series of cardiac pulsations is often an exact reproduction of the first, and also by the close resemblance between the tracings obtained in this way and those registered by the sphygmograph, or an enlarged modification of it, such as Galabin's cardiograph, applied over the apex-beat. Pond's sphygmograph may also be used as a cardiograph.

A cardiogram collected on a healthy person by the instrument described is here given. One cardiac revolution is figured. The several waves may be interpreted as follows. The wave *a*, in the line of ascent, corresponds with the early part of the ventricular diastole. The wave *b* corresponds with the true auricular systole; from *b* to *d* the line marks the true impulse caused by the ventricular contraction, the rounding of the heart, and its pressure against the chest-wall. The wave *c*, at the summit of the curve, immediately follows the closure of the auriculo-ventricular valves, which does not always form the summit of the curve, but occasionally in slower cardiac contractions is marked by a wave below the summit. The waves between *c* and *d* are oscillations produced by the closure of the auriculo-ventricular valves. The length of the summit *c* to *d* is important; it is long and sustained in hypertrophy, narrow and pointed in dilatation. Its length is a measure of systolic strength. The closure of the aortic valves is marked by *d*; while *e* marks the closure of the pulmonary valves, separated by an interval of ·05 to ·09 second. If the pressure in the aorta falls and that in the pulmonary artery rises (pulmonary second sound accentuated), *d* and *e* approach and may no longer be distinct. In the above cardiogram the period of ventricular contraction is measured by the space between the commencement of the line of ascent after the wave *b*, to the point *d*, which marks the termination of the systole; the rest of the curve is diastolic. The wave *d* is prominent in hypertrophy of the left ventricle.

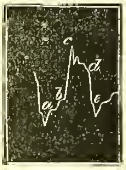

Fig. 23. Cardiogram.

The clinical value of the cardiograph has yet to be fully established. It has hitherto been useful in showing the relation of præsystolic murmur and thrills to the ventricular and auricular contractions; in demonstrating modifications of the form of impulse in adherent pericardium; in recording a considerable increase in the wave *a*, and a sudden rising of the trace after *a* to *b*, as signs of aortic insufficiency; and in the recognition of the relation between reduplication of the heart-sounds and respiratory influences. The wave *a* is larger the more sudden the relaxation of the ventricle, and thus it is increased by the influx of the blood in cases of aortic and mitral regurgitation. Waves following *a* usually indicate vibrations and thrill due to mitral stenosis, while prominence of wave *b* indicates auricular hypertrophy.

The cardiograph is also of great value in registering the form of movement of pulsating tumours and aneurysms. In its application, it is sufficient to hold the instrument firmly over the apex-beat, and to record the pulsations at the end of expiration, the breath being stopped for a brief interval. When the influence of respiration is to be observed, this precaution is of course unnecessary; but it must be borne in mind that the movement of the chest-wall modifies the tracing.

(Balthazar) Walter Foster.

CARDITIS (καρδία, the heart).—Inflammation of the substance of the heart. *See* Heart, Inflammation of.

CARIES (*caries*, rottenness).—A destructive inflammatory disease of bone, analogous to ulceration of soft tissues. *See* Bone, Diseases of.

CARLSBAD, in Bohemia. Thermal alkaline sulphated waters. *See* Mineral Waters.

CARMINATIVES (*carmino*, I card, or cleanse).

Definition.—Substances that aid the expulsion of flatus from the stomach and intestines, and relieve griping.

Enumeration.—The principal carminative remedies are—the essential Aromatic Oils, for example, Peppermint and Cloves; Chloroform; Charcoal; Ethers; and Camphors, and substances containing them.

Uses.—The uses of carminatives are sufficiently indicated in the preceding definition. They are extensively administered in cases of flatulent dyspepsia, especially when it is associated either with disease or disorder of the heart, or with a nervous or hysterical state of the system. A combination of several different carminatives is usually more successful than the exhibition of a single drug, one of the best being a mixture containing Spirit of Ether, Aromatic Spirit of Ammonia, and Tincture of Orange. Given along with antacids they are useful in correcting acidity, as in the favourite Soda-mints; and they are frequently prescribed with purgatives to prevent pain—an application illustrated by the Compound Rhubarb Pill.

T. Lauder Brunton.

CARNIFICATION (*caro*, flesh; and *fio*, I become).—A condition of the lung in which it resembles flesh. The term was formerly applied to the transformation of any tissue into a flesh-like substance. *See* Lungs, Collapse of.

CARPHOLEGY
CARPHOLOGY (κάρφος, chaff; and λέγω, I collect).—The movements of the hands and fingers observed in certain delirious patients, as if they were searching for or gathering imaginary objects. A familiar illustration of the act is 'picking of the bedclothes.' *See* Typhoid Fever.

CARTILAGE, Diseases of.—Synon.: Fr. *Maladies du Cartilage*; Ger. *Knorpelkrankheiten.*—For a due appreciation of the abnormal conditions to which cartilage is subject, a brief description of this tissue in its healthy state is necessary.

The *temporary* cartilage, which forms the early skeleton, gradually undergoes conversion into bone, leaving at the joint surfaces a thin layer, the *articular* cartilage, which never becomes ossified. Certain other portions of the skeleton also retain their cartilaginous condition throughout life; these are known as the *permanent* cartilages, and as examples the cartilages of the ribs, ears, and nose may be named. The extremities of the long bones, or epiphyses, remain separate from the shaft for a varying period after birth, and so long as the bone continues to grow, they are attached to it by a thin but important layer of cartilage, called the *epiphysial* cartilage. There are also the *fibro-cartilages*, in which the fibrous and cartilaginous elements are found in varying proportions, according as the tenacity of the one or the elasticity of the other material is required.

Cartilage is altogether destitute of nerves, and therefore of sensibility; and it is equally devoid of blood-vessels, being nourished by imbibition from the vessels of the neighbouring parts. All cartilages, except the articular and the fibro-cartilages, are covered by a fibrous membrane, the *perichondrium*, which is similar to, and subserves the same purposes as the periosteum. When cartilage has been destroyed, it may be replaced by fibrous tissue or by bone, but it is never reproduced.

Under the microscope a section of cartilage presents a transparent, structureless matrix, studded with nucleated cells; these cells are flattened and arranged parallel with the free surface of the cartilage, whilst more deeply they are elongated and grouped vertically. The nutrient materials are absorbed from the neighbouring blood-vessels, and transmitted throughout the cartilage by means of these cells. In those cartilages where tenacity or flexibility is needed, this hyaline substance is denser and more distinctly fibrillated than in the others.

Summary of Diseases.—Cartilage being non-vascular, its inflammation is of a modified type, and it may undergo degenerative changes as the result of impaired nutrition. In uncomplicated disease of cartilage there is no inflammatory exudation, and when lymph or pus is found in a joint, it is obvious that other structures have become inflamed.

1. The ensiform and costal cartilages, with those of the trachea and larynx, show a great tendency to *ossification*, as the result of senile changes; they are also liable to *necrosis*. The articular cartilages never ossify, but large or small portions of them may perish and be detached, in consequence of some interference with their supply of nutriment from the subjacent bone. In pyæmic joint-effusions the cartilage softens, and is rubbed off the most prominent portions of the articular surfaces in a manner quite characteristic. In osteo-arthritis, one of the earliest of the pathological changes occurs in the articular cartilage. The cells proliferate, the primary capsules enlarge and fill with secondary capsules. The matrix fibrillates and softens, and by degrees the cartilage is worn off the central part of the articulation, exposing the bone underneath; laterally, where the pressure and friction are less, the cartilage cells proliferate and form a tuberculated margin, which subsequently ossifies.

2. The cartilages of the epiglottis, ears, nose, eyelids, and Eustachian tube have little disposition to ossify, but they are liable to *ulceration*, especially of the syphilitic variety; in these cases the diseased action commences in the skin or mucous membrane, and spreads to the cartilage by contiguity.

3. The cartilage of the external ear is often the seat of *chalk-stones* in gouty persons, and similar deposits of urate of sodium are found in the articular cartilages.

4. The epiphysial cartilage may be the seat of *inflammatory changes*, generally very acute, which lead to separation of the shaft from the epiphysis, a condition which, whether the result of disease or accident, is of great moment, inasmuch as the destruction of this layer of cartilage checks further growth at this end of the bone.

Primary epiphysitis is rare: the changes in the epiphysis usually spread to it from the extremity of the diaphysis. Syphilis, especially of the inherited form, is the most common cause of this disease. Injury, particularly in strumous children, is also a factor in its production. The acute form is often associated with general septicæmia, and is followed by destructive changes in the adjacent joint.

5. Cartilage is not primarily attacked by *cancer*, but it may become involved by the spread of a malignant tumour. The *epithelial* form of cancer not infrequently

extends from the mucous or cutaneous surface, in which it originated, to the subjacent cartilage.

6. The articular cartilages are liable to certain structural changes as the result of disturbed nutrition; and the fibro-cartilages are also subject to the same abnormal conditions.

Ulceration, *absorption*, *degeneration of cartilage*, are terms used to denote a series of destructive changes which take place in the substance of articular cartilage, and lead to its partial or complete removal. These changes may originate in the cartilage itself, or they may be secondary to disease of the bone or synovial membrane; however this may be, the morbid action is the same, and consists in increased cell-development, with disintegration of the hyaline substance.

According to the observations of Goodsir and Redfern, the cartilage-cells become enlarged, filled with nucleated corpuscles, and arranged irregularly; the distended cells then burst, and set free their contents upon the surface, or in the midst of the altered hyaline substance. Whilst the cell-changes are taking place, the matrix softens: in acute cases it rapidly disintegrates and is discharged; but when the disease is more chronic, it splits up into fibres which remain attached by one end to the cartilage, and at the other project loosely into the interior of the joint, giving a villous appearance to the affected spot. The remains of the matrix and the granular contents of the cells together form a fibro-nucleated membrane, which ultimately is converted into fibrous tissue, and constitutes the sole medium of repair when a cure is effected. When this membrane is recent it has an indistinct granular appearance, from the presence of nuclei amongst the fibres, and according to Rainey these nuclei are often converted into fat-globules; when the membrane is of older date it is distinctly fibrous; and no doubt the several appearances which the membrane presents under different circumstances have led to the several terms *fibrous*, *fatty*, and *granular degeneration* being applied to this disease, in the belief that they were really distinct pathological conditions.

Changes of this kind may be primary, as in osteo-arthritis, but they are commonly secondary to disease in the articular ends of the bones, the result of syphilis, tubercle, or injury. W. Mac Cormac.

CASEOUS DEGENERATION.—A form of degeneration in which the products present the appearance of cheese. *See* Degenerations.

CASTS (derived from the Middle English word *casten*, which is adapted from the Old Norse *kasta*, signifying *to cast* or *throw*). Synon.: Fr. *Cylindres*; Ger. *Cylindern*.

Definition.—A term applied to moulds of gland-tubules and hollow viscera, thrown off in certain states of disease.

Classification.—The varieties of casts met with may be thus grouped:—

A.—Casts of Gland-Tubules.

- **I. Of the Uriniferous Tubules.**
  - Blood-casts.
  - Pus-casts.
  - Hyaline casts.
  - Granular casts.
  - Epithelial casts.
  - Fatty casts.
- **II. Of the Seminal Tubules.**
- **III. Of the Gastric Tubules.**
- **IV. Of the Bile-ducts.**
- **V. Of the Cutaneous Glands.**

B.—Casts of Hollow Viscera and Passages.

- **I. Of the Alimentary Canal.**
- **II. Of the Urinary Bladder.**
- **III. Of the Female Genital Passages.**
- **IV. Of the Respiratory Passages.**

A.—Casts of Gland-Tubules.

I. Of the Uriniferous Tubules.—Dr. F. Simon, of Berlin, is usually credited with having been the first to describe these bodies in his work on *Medical Chemistry*, published in 1842; but it appears that before then they had been noticed and described by Vogla in 1837 and 1838, by Rayer in 1838, and by Nasse of Marburg in 1842. These observers, however, do not seem to have entered on the question of the origin, structure, or significance of these bodies, and for years they were looked upon rather as curiosities, and by some writers were wholly disregarded. Henle, in 1844, appears to have been the first to refer their origin to the coagulable matter of the blood, but it was some time after that date before their value in the diagnosis and prognosis of renal diseases came to be appreciated. This result has been mainly effected in this country by the labours of Basham, Lionel Beale, George Johnson, William Roberts, Dickinson, and Grainger Stewart.

Casts may be formed in any part of the kidney. They have been found in the convoluted tubules even up to the Malpighian capsules, and also in the straight tubules. Various modifications in shape and contour probably occur in the course of their passage along the tubes, even to the inclusion of a small cast in one of larger size.

Characters.—The urinary casts are mostly cylindrical in shape, frequently somewhat coiled and bent, and occasionally forked. Their length, depending very much on accidental circumstances, varies considerably. In sections of the kidney they may be occasionally traced for some distance in the tubules; but they become broken up into smaller pieces after leaving the gland. In diameter casts range between $\frac{1}{1000}$ and $\frac{1}{500}$ of an inch—the former being known as 'small,' the latter as 'large' casts. The greater number are of a 'medium' size of $\frac{1}{700}$ of an inch. The diameter of the casts is in part determined by the calibre of the tubule in which they are first formed, and in part by any subsequent additions they may receive in their passage outwards. Dr. Beale has suggested that after their formation the casts may probably shrink. In tubules that have become abnormally dilated or contracted, casts beyond the limits above mentioned may be found.

The appearance of renal casts varies considerably, not only in different kidney-diseases, but also in various stages of the same affection. In all cases the cast consists of a solid cylinder of a transparent or very faintly granular substance, which is rarely fibrillated. It was formerly accepted that these bodies were produced by a coagulation of fibrin due to an escape of blood-plasma into the tubules, and hence they were known as 'exudation-cylinders'—a term still often employed. It is easy to understand the formation of casts in this manner, and it is certain that such *blood-casts* do occur, whether as shreds of fibrin with abundance of blood-corpuscles in its meshes, or as casts consisting of little more than pure fibrin with its characteristic fibrillated appearance. In a similar manner *pus-casts*, so-called, may be produced.

In most cases of renal disease, however, in which casts are found in the urine, these bodies usually appear as transparent and faintly granular, tolerably uniform cylinders, frequently somewhat rounded at the extremities, and often overlooked unless searched for with care. In them no sign of fibrillation is to be discerned, and they do not correspond in their chemical behaviour to fibrin. These are the *hyaline*, *transparent*, or *waxy* casts, which may be large, small, or medium in diameter; the largest and smallest casts met with belong to this variety. Several views, supported by experimental evidence, prevail as to the nature and source of these bodies; and it is not improbable that, differing in their composition, they may originate in either of the following ways:—

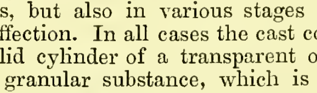

Fig. 24.—Blood-Casts.

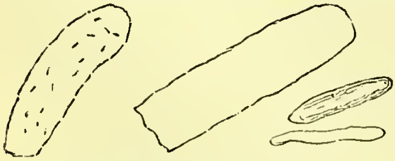

Fig. 25.—Hyaline Casts.

(*a*) The coagulation of some proteid material, which has transuded from the blood-plasma into the tubules, the epithelial cells being unaffected, and, so far as is known, taking no share in the formation of the cast. Such may be called '*transudation cylinders*,' and masses of the coagulated substance are occasionally to be seen between the epithelial cells and the membrana propria of the tubule. The exact nature of the material is unknown; as stated above, it is not ordinary fibrin, but is probably some proteid derivative which has been made to coagulate—perhaps, as has been suggested, by the acid urine, or by the gland-cells.

(*b*) In contrast to the foregoing, it has been demonstrated that the living epithelium may, under certain conditions of irritation, as from cantharides, swell up, and, undergoing a form of colloid or mucoid degeneration, become transformed into clear transparent casts of the tubes, sometimes exhibiting a partial segmentation, indicative of their origin from several coalesced portions, or involving the remains of cells which have been only partially metamorphosed. To these the term '*fusion cylinders*' has been applied. Or the cells, without being entirely converted into colloid matter, may appear to secrete drops of such material, which are moulded in the tubules into hyaline casts—the so-called '*secretion cylinders*.' Here, again, the actual nature of the cast-substance is unknown, though described as mucoid or colloid; and from the great variability in its behaviour to staining fluids and other reagents, it most probably differs much in composition. Occasionally some of the large waxy casts will give the characteristic reactions, with iodine or with methyl-violet, of lardacein; even, it is asserted, when the kidney itself offers no evidence of lardaceous change.

Whatever may be the true explanation of their formation, they present themselves as semi-solid and somewhat viscid cylinders, readily entangling adjacent matter. Due to this property is much of the variety they offer; thus, should the epithelium of the tubules be loosened, as in nephritis, the cells will adhere to the cast which has been formed in the lumen of the tube, and an *epithelial cast* will be voided. Such casts may present but one or two cells on their

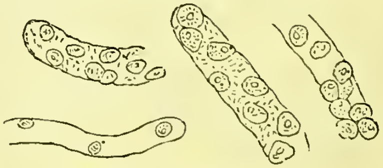

Fig. 26.—Epithelial Casts.

surface, or may appear as if consisting only of coherent epithelial cells. Should the cells have undergone fatty degeneration, the cast will be pervaded with oil-globules of all sizes, more or less escaped from epithelial cells, according to the extent of the degeneration; this constitutes a *fatty cast*. Very frequently the casts are finely or coarsely *granular*, this appearance being produced by the involvement in the base-substance of granular matter derived from broken-down epithelial cells or blood-corpuscles, molecular fatty matter, amorphous urinary salts, or micro-organisms. Granular casts may exhibit a faint yellowish or brownish tint depending on their constitution. In a similar way casts may be found containing *crystals* of oxalates, triple phosphates, hæmatoidin, salts of fatty acids, &c.

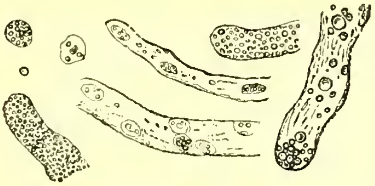
FIG. 27.—Fatty Casts.

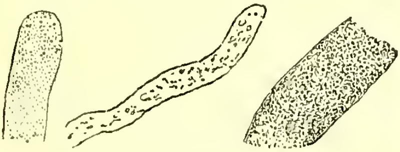
FIG. 28.—Granular Casts.

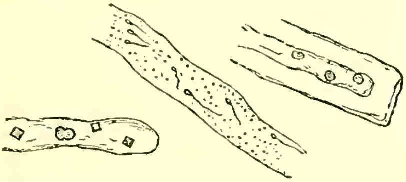
FIG. 29.—Casts enclosing crystals; and a smaller cast; also of seminal tubule with spermatozoa.

It is very commonly the case that more than one variety of cast occurs in the same urine—epithelial and hyaline, or granular and fatty, often co-existing. Corresponding to the casts in the urine, free epithelial cells, blood-corpuscles, fat-globules, and salts, amorphous or crystalline, are always found, and almost always albumin, though not of necessity is there any correspondence in the quantity of this substance and the number of casts. The epithelial cells, whether free or on the cast, are rarely quite normal in appearance. The pathological changes associated with their desquamation have at the same time altered them more or less. Not infrequently the cells of an epithelial cast present all the microscopic characters of leucocytes produced by an abnormal proliferation of the renal epithelium.

Method of examination.—Samples of urine (three or four ounces) suspected to contain casts should be allowed to stand at least three hours (and longer if the urine be of very low specific gravity) in perfectly clean conical glasses, and a few drops should be removed from the bottom with a pipette, and covered in the usual way on a glass slide. They may be so abundant as to form a visible sediment in the glass. For all practical purposes a $\frac{3}{4}$-in. objective, giving with the eye-piece a magnifying power of about 350 diameters, is sufficient. The hyaline casts are often so transparent as to escape any but the most careful observation, and then a little dilute staining fluid, introduced beneath the cover-glass, much facilitates their detection; cutting off some of the transmitted light has a similar effect. It is to be remembered that casts retain their characteristics far better in acid than in alkaline urine; in the latter they are very apt to break up and disappear. As a rule there is no mistaking a renal tube-cast, but occasionally a transparent or granular streak may be noticed, the nature of which cannot be positively stated; shreds of mucus, especially when mixed up with granular matter, are the commonest objects which simulate casts, and are not infrequent in disease of the bladder or prostate; their disappearance on the application of liquor potassæ and a little heat to the slide determines their character.

CLINICAL SIGNIFICANCE.—Valuable as is the evidence of the changes in the renal epithelium afforded by the detection of these bodies in the urine, their recognition and comprehension is nevertheless but one of the means to be employed in the study of kidney diseases. Of themselves they afford information, rarely, if ever, conclusive when taken alone. Without doubt certain renal diseases may exist, and may continue throughout their course, either to recovery or death, without the occurrence of casts in the urine; and, on the contrary, casts may be found entirely independent of renal disease. But for all practical purposes it may be accepted that when casts do occur, they generally indicate the existence of a disease of the kidneys which is possibly incurable, certainly serious. With our present knowledge of the conditions under which they are found, it would appear that their presence in the urine does not necessarily imply the existence of an inflammatory state of the kidney, for they may accompany simple congestion, the gland substance being intact; but doubtless in the majority of cases they are evidence of a nephritis, acute or chronic, and the subsequent associated degeneration. Besides the value of casts in determining the existence of kidney-disease, they are further most important aids in helping to distinguish what variety or stage of disease it may be, and also in making out the actual condition of the kidney, thus furnishing valuable data on which to form a prognosis, and to suggest a plan of treatment. Little is to be concluded, however, from one examination. This should be performed frequently, as in that way alone can the morbid progress in the kidney be recognised.

From what has been said of the nature of casts, it should be expected that several varieties of these bodies occur at the same time in the urine. It is rare for any variety to exist singly, at least for any time. In such cases their significance is ascertained by careful study of coincident circumstances, and especially by a frequent comparison, in order to determine which variety is in excess.

The fact that casts are very abundant in any sample of urine is not in itself of necessity a serious sign. Thus in 'granular kidney'—one of the most serious of all renal affections—the casts may be, and usually are very few, and require careful looking for; whilst in the convalescence from acute nephritis they may be extremely numerous. In chronic nephritis, however, the number becomes an important element in the consideration.

Blood-casts are diagnostic of hæmorrhage into the tubules, whether that be due to wounds of the organ, or to intense arterial hyperæmia or venous congestion—causing escape of blood from the capillaries of the glomeruli.

Pus-casts may indicate the bursting of a renal abscess into the tubes, and coagulation of the escaped pus; or a diffuse suppuration of the gland substance.

Hyaline casts.—The large forms of this variety chiefly occur in chronic nephritis, and are therefore usually a grave sign. Produced in tubules which have been denuded of their epithelium, or in others that have become dilated from contractions in the intertubular substance, they indicate an advanced condition of disease. Exceptions to this do occur, and large hyaline casts may be found in acute and curable cases.

Small hyaline casts are formed in both acute and chronic forms of renal disease. They therefore become valuable as means of diagnosis only in conjunction with other signs, such as the history of the case, the character of the other urinary sediments, &c. They are frequently seen in acute nephritis, particularly in the later stages of the disease, and are then formed in tubes which have not been stripped of their epithelial lining. In simple congestion of the kidney they may be formed from a coagulation of the fibrin of the effused plasma. When associated with the large variety they usually indicate a chronic and advanced stage, being then found in tubules that have become contracted. These two varieties of hyaline casts are common in the lardaceous kidney, and similar casts have been met with in the tubules in cases of diphtheria.

Granular casts.—The significance of these is very variable. As has been said, the granular casts differ much in nature, and no positive diagnosis can be made upon them alone. They may occur in conjunction with blood-casts where the corpuscles have broken down, and will then generally indicate a commencing recovery from an acute stage. A similar interpretation may sometimes be put on casts whose granulation is due to fat-molecules resulting from the degeneration of inflammatory products. Large, dark, and coarsely granular casts are more particularly noticed in 'granular kidney,' where indeed they may be the only casts found. In such circumstances they become a very serious sign. In the later stages of chronic nephritis the epithelial cells disintegrate and produce granular casts.

Casts consisting of micro-organisms entangled in a basic substance have been met with in septic affections of the kidney. They are for the most part distinguishable from other 'granular casts' by their resistance to such reagents as nitric acid and liquor potassæ, which dissolve up mineral granular matter.

Epithelial casts.—These are more especially met with in the earlier stages of nephritis during active proliferation, and their significance much depends on the character of the epithelium cells, which may differ but slightly from the normal, or may be so altered as to resemble leucocytes in appearance, or they may be loaded with fat. They may be very abundant at first; later on, when the hyaline variety appears in the urine, becoming less numerous.

Fatty casts.—Probably no casts are so general in their occurrence as the fatty. Their presence may be of the gravest import, or they may betoken commencing recovery, and more than any, therefore, must they be considered in connexion with other circumstances. The casts that are found in the later stages of acute nephritis during convalescence are in part fatty. The inflammatory products undergoing this degeneration are those thrown off. Hyaline casts, both large and small, frequently present a few oil-globules on their surface. In certain forms of chronic nephritis the casts may appear as if made up of oil-globules only. In such case an advanced stage of fatty degeneration of the gland is distinctly indicated, and the persistence of fatty casts is generally taken to signify the same; though such casts have been known to continue in numbers for some weeks, and to be followed by recovery.

Casts in non-albuminous urine.—The occurrence of renal tube-casts in such urine is now well recognised, being chiefly met with in cases of prolonged jaundice, lithuria, oxaluria, diabetes, and more rarely after very severe exercise. They are of the hyaline variety, and probably owe their origin to the epithelial cells rather than to the escape of any material from the blood, but their pathogenesis cannot be regarded as being understood. Their entire independence of albuminuria should not be too readily assumed, for, apart from the fact that this condition may only exist to such a very slight degree as might be overlooked, it may be that the presence of albumen is intermittent, the casts being voided in the intervals.

Cylindroids is a term given to certain spurious casts of a long, flattened, filamentous character which have been found in the urine of scarlet fever and cholera patients, also, it is said, more frequently in children. Whether they are renal in origin is very uncertain, and albuminuria does not always accompany them.

II. Of the Seminal Tubules.—Dr. Beale has pointed out the occasional existence in urine of casts containing spermatozoa (*see* fig. 29). The base-substance of these bodies is a viscid tenacious mucus, and they are usually much larger than the casts derived from the uriniferous tubules. They have not been found associated with inflammatory conditions of the testicle, and do not correspond pathologically to the renal casts just described.

III. Of the Gastric Tubules.—In inflammation of the gastric mucous membrane, especially in scarlet fever, a desquamation of the epithelial coat involving the glands has been noticed. The casts of the follicles have been found in the vomit, and more abundantly in the contents of the stomach *post mortem*. Their length is variable, and in width they range from $\frac{1}{600}$ to $\frac{1}{1000}$ of an inch. The base-substance is described as fibrinous, and is covered more or less completely by altered epithelial cells and granular *débris*.

IV. Of the Biliary Ducts.—In the centre of gall-stones there have been found long, hair-like threads, often branched, and generally under $\frac{1}{200}$ of an inch in diameter, consisting of mucus, inspissated bile, and epithelium, which have been regarded as casts of the smaller biliary tubes.

V. Of the Cutaneous Glands.—In the various skin-affections which are associated with desquamation of the cuticle, casts of varying length, coming from the sweat- and sebaceous glands, are thrown off as part of the general shedding of the epidermis. Such bodies are hollow tubes, and bear no resemblance to the renal casts in nephritis.

B.—Casts of Hollow Viscera and Passages.

From time to time, more or less perfect casts of these organs are met with. The conditions which determine their occurrence are but imperfectly understood; they are in most cases associated with inflammation of the surfaces from which they are thrown off, especially with those forms of inflammation accompanied by the formation of false membrane, croupous or diphtheritic. A mere catarrhal inflammation, provided the resulting mucus be sufficiently viscid and coherent, may entangle the proliferated epithelium, and be detached as more or less complete casts of the surface.

I. Of the Alimentary Canal.—Solid casts of the tonsillar crypts and branches consisting of inflammatory products, are occasionally expectorated in follicular tonsillitis and diphtheria.

Muco-cellular casts of several inches in length, and more or less perfect, have been met with from the œsophagus, and more rarely pieces have been detected in vomit as coming from the stomach. Casts of portions of the gullet formed of dense masses of aphthæ have also been described. More frequently seen are intestinal casts—indeed, small flocculent pieces from the surface of the colon are far from uncommon, especially in association with chronic constipation. These also consist of viscid mucus and epithelial cells, matted into tough, coherent pseudo-membranes, often forming complete hollow moulds of the tube, large or small, and varying in length from a few inches to several feet; they have been observed to be solid cylinders of jelly-like mucus and embedded cells. Occasionally they retain on their surface the impression of the follicles, sacculations, and other inequalities of the intestinal surface. See *Path. Soc. Trans.*, vols. ix. and xxiii.; *Brit. Med. Journ.* 1887, pp. 617 and 832.

II. Of the Urinary Bladder.—A complete exfoliation of the mucous membrane of the bladder has been occasionally observed in puerperal women. It does not appear to be always the result of inflammation, and though the detachment may be complete, perfect recovery may follow. In structure such bodies consist of epithelial cells in varying stages of degeneration, felted together by mucus and fine granular material. The surface is frequently thickly coated with urinary salts. The conditions giving rise to their formation are quite unknown, though retention of urine is associated with their occurrence.

III. Of the Female Genital Passages. Casts of the uterus and vagina have been frequently noticed. The latter occur as hollow moulds of the canal, more or less complete, and consisting of layers of epithelium cohering by a tough mucus. They have been known to follow astringent injections. Partial casts of the vagina formed of diphtheritic membrane have also been seen.

Uterine casts are of commoner occurrence, and are of various kinds. Exclusive of solid moulds of the cavity formed of coagulated blood, the states of pregnancy and menstruation are each liable to give rise to the formation of membranous casts of the surface, complete or partial, and usually accompanied by much pain in their extrusion (membranous dysmenorrhœa). The menstrual cast is rarely entire, and is usually about one and a-half inches long, and one-twelfth of an inch thick, of a translucent appearance, and consists of the decidua ordinarily shed at the period, but of greater consistency than normal. It may be that the cast passed at any one time is the product of a previous menstrual period. The cast expelled in extra-uterine pregnancy is much larger and thicker, appearing as a triangular bag with orifices at the angles corresponding to the openings of the Fallopian tubes and cervix; externally the bag is rough and shaggy, but on the inside it is smooth, and shows the orifices of the uterine glands.

IV. Of the Respiratory Passages.—The mucous membrane of the respiratory tract is remarkably prone to those forms of inflammation which are distinguished by the production of considerable quantities of new material highly coagulable in character, to which the terms croupous and diphtheritic are applied. Of such material are the different forms of casts of the air-passages composed, the products of simple catarrhal inflammation never being sufficiently coherent to retain the shape of the surface from which they are derived. In these conditions the epithelium of the mucous membrane comes to be replaced by a layer of material derived from the metamorphosed epithelial cells, with a variable amount of coagulated fibrin formed from the effused blood-plasma. Such false membrane appears under the microscope to be made up of interlacing fibres of a clear homogeneous-looking substance, felted together in all directions, and containing in the meshes leucocytes, altered epithelial cells, blood-corpuscles, and a small quantity of serum. It is easy to understand that the extent to which the materials constituting this membrane infiltrate the deeper layers of the mucous membrane must vary considerably; yet on the extent of infiltration, and consequent adherence, depends in great part the distinction between croupous and diphtheritic exudation. More important is the difference in the changes which occur in the epithelial cells in these two conditions. In the diphtheritic they are far more profoundly altered, undergoing a process of necrosis and fusion into a mass of coagulated tissue, filaments of fibrin and leucocytes infiltrating the subjacent parts. In the croupous state the epithelium, though degenerating, is far less changed, and the cells desquamate more freely. False membranes thus formed are loosened by the effusion of serum beneath them, and subsequently expelled in shreds or as entire casts.

In the larynx and trachea, the new material forms more or less complete layers, covering the vocal cords, dipping into the ventricles, and even blocking up the laryngeal cavity completely. Occasionally a cast of the whole length of the trachea, and part of a main bronchus, may be expectorated.

When this inflammatory product originates in the bronchial tubes, it forms the so-called bronchial polypi, so characteristic of plastic bronchitis. It is rare for more than very limited areas of the air-passages to be so affected, but within these areas perfect casts of the entire extent from trachea to alveoli may be obtained. Expectorated as irregular, rolled-up, and twisted masses, they are capable of being shaken out in water into ramifying whitish or pinky white moulds of the tubes, varying in length from one and a half to six or seven inches, and of a maximum diameter of half an inch, often with swollen ends corresponding to the infundibula. They are either hollow and membranous, or solid, and in the latter case frequently present indications of being made up of concentric layers. Sometimes only one of these casts may be expectorated, especially if a large one; at other times they may be re-formed again and again, and large quantities may be coughed up daily. Microscopically they consist of altered epithelial cells, leucocytes, red corpuscles, fat-globules, and very rarely octahedral crystals, entangled in a fibrillar or granular base-substance. Similar casts of the smallest tubes are exceptionally found in the expectoration of acute croupous pneumonia, but are commonly to be found *in situ* on post-mortem examination. W. H. Allchin.

CATALEPSY (κατάληψις, a seizure).—Synon.: Fr. *Catalepsie*; Ger. *Starrsucht.*

Definition.—A disease of the nervous system, characterised by attacks of powerlessness, commonly with loss of consciousness, and accompanied by a peculiar form of muscular rigidity, in which the limbs remain for a time in the position in which they are placed by passive movement. On account of the trance-like state which exists in the attack, the name is sometimes applied to simple trance, but should be restricted to the condition in which there is the peculiar state of the muscular system. The origin of the name is connected with the old spiritualistic pathology, which referred such sudden states to the action of an immaterial agency, and recognised as such only some immaterial agent of personal nature.

Ætiology.—Catalepsy may occur at all ages between six and sixty years, and in both sexes, but it is incomparably more frequent in the female sex and in early adult life, at or soon after puberty. It is, in the majority of cases, associated with distinct evidence of hysteria. In other cases, in which no hysterical symptoms have preceded it, the affection may be traced to such exciting causes as give rise to the hysterical paroxysm. Nervous exhaustion is the common predisponent; and emotional disturbance, especially religious excitement, or sudden alarm, or blows on the head and back, are frequent immediate causes. It occasionally appears in the course of mental affections, especially melancholia, and is said to occur as an early symptom of epilepsy, but it is much more likely that the fits thought to be epileptic were really hysteroid. In an imperfect form it has appeared to be due, in some cases, to paludal poisoning or to other toxæmic states, as chloroform-narcosis. In a few instances meningitis, and other organic cerebral or spinal diseases, have caused a cataleptoid condition; but these cases are too rare and diverse to allow of any inference from them.

Symptoms.—Catalepsy is usually paroxysmal, attacks lasting hours or days being separated by periods of freedom; less commonly a single prolonged attack constitutes the whole affection. In some cases headache, giddiness, or hiccough has preceded the attack. The onset of the special symptoms is usually sudden, commonly with loss of consciousness. The whole or part of the muscular system passes into a state of rigidity. The limbs remain in the position they occupied at the onset, as if petrified. The muscular rigidity is at first considerable, and movement is resisted; but after a short time the limbs can be moved, and then remain in the position in which they may be placed. The resistance to passive movement is peculiar: it is as if the limbs were made of wax, and hence the condition has been termed *flexibilitas cerea*. The rigidity commonly yields slowly to gravitation. The countenance is usually expressionless. The respiratory movements and heart's action are weakened. Substances placed in the back of the mouth are swallowed, but slowly. The state of sensibility varies; in profound conditions of catalepsy it is lost to touch, pain, and electricity, and no reflex movements can be induced even by touching the conjunctiva, a state of mental trance being associated. In other cases partial sensibility remains, and reflex phenomena may be excited. In rare instances hyperæsthesia is present. In induced catalepsy there is often a peculiar local exaltation of reflex action, so that stroking the skin over a superficial muscle causes an increased contraction of it. This involves a change of posture, in consequence of a definite sensory impression, and an analogous effect may be produced through the special senses, especially hearing; if a ticking watch be brought near the subject's ear, the posture is changed with a start, the head turned towards the object, and the eyes, if previously closed, may be opened, although the cataleptic condition continues as before. Consciousness, although usually lost, may remain, but it is seldom intact, being generally in an obscured condition. The temperature is commonly lowered in a long seizure. The attack may last a few minutes or several hours. Recovery is gradual or sudden; sometimes the patient at first is unable to speak. A sudden respiratory stimulus—such as blowing on the face—will often terminate an attack of induced catalepsy. Sometimes a strange periodicity may be observed in the occurrence of the paroxysms. In the intervals between the attacks, headache, giddiness, or hysterical manifestations may be present, or the patient may feel and seem perfectly well.

Pathology.—Concerning the nature of the disease there has been much speculation, but little definite knowledge. It may probably be placed between epilepsy and hysteria in the scale of maladies, but nearer the latter than the former, and as regards the nature of its chief feature, it may be regarded as essentially one of the motor. But there is also distinct interference with the intellectual processes, and interruption of the connexion between the will and the motor centres.

To say this is only to express obvious facts in general terms, and affords no explanation of them. A careful consideration of their nature may give us at least the material for thought on the subject. The wax-like rigidity is an excess of the action by which muscles are constantly adapted to posture, *i.e.* to the distance between their attachments, and yet preserve the same degree of physiological tone. This is effected by a reflex process, the afferent impulse for which probably comes from the afferent muscle nerves, and is generated by the sum of the related tension and compression of the interstitial tissue in which these nerves begin. The motor cells (and therefore the muscular fibres) are active in inverse proportion to these impulses, and so the opponents of a passive movement relax, the muscles shorten that correspond to it in their action; they are thus adapted to posture, and, if this process is in excess, the cataleptic rigidity must of necessity ensue. But it is probable, on many grounds, that the afferent impulses from the muscles have a double action—a lower on the motor centres of the spinal cord, and a higher, through the cerebellum, on the motor centres of the cortex cerebri. The phenomena suggest that the action is similar on each; since the cortical cells govern the spinal cells, their functional states must be in related correspondence. Thus the afferent impulses that regulate adaptation to posture must do this through both cortical and spinal centres simultaneously. The excessive action of catalepsy may be in the cortical and not in the spinal mechanism. This would enable us to understand the otherwise strange fact, that the cataleptic state may be induced by influences acting on the brain, as in the induced catalepsy of hysteria. The motor cortical centres, whence the pyramidal fibres proceed, are probably the lowest of the centres of the cortex; the induction of catalepsy may consist simply in the inhibition of higher centres that act on and through them and normally restrain them. The over-action of these entails the over-action of the spinal centres, and the wax-like rigidity results. Thus, too, we can understand that consciousness should be lost or strangely changed during the attack, and its relation to emotion as a cause. So, too, it is clear that every forced change of posture will leave the condition of the centres essentially unchanged, although there will be a slightly different distribution of activity. Arrest the inhibition which prevents the higher cortical centre from acting on the lower, and the resumed control involves restraint of the over-action of the latter and of the spinal centre, and the cataleptic state is at an end.

Diagnosis.—The peculiar rigidity of catalepsy is characteristic, invariable, and renders the diagnosis a simple matter. Hysteria with tonic spasm has been erroneously termed catalepsy, but is distinguished by the local position of the spasm, and the fact that it does not yield to passive force. The malady most likely to be confounded with catalepsy is tetany, since in it there are attacks of tonic spasm involving all the limbs. But in this the rigidity is fixed; it cannot be overcome, and the posture of the limbs changed; while the hands are in a characteristic posture, with the fingers straightened at the middle joints, and their points and that of the thumb brought together. The condition is sometimes simulated: in true catalepsy the rigid limb slowly yields to the influence of gravitation, and more rapidly if a weight be attached to it; in the feigned form the limb and weight are held firm.

Prognosis.—The prognosis is favourable in simple catalepsy, in proportion to the freedom of the intervals from affections of sensibility or motion. In pronounced hysteria and psychical affections the condition is often obstinate; and, by interfering with the due nourishment of the system, may cause grave inanition.

Treatment.—During the attack itself little can be done save an attempt, which may be repeated at intervals, to rouse consciousness by external stimulation. The ordinary applications—ammonia to the nostrils, cold douches, &c.—often fail in the spontaneous form, but this does not hold true of most cases of induced catalepsy, in which any stimulus that excites a respiratory effort commonly arouses the patient and cuts short the attack. A pinch of snuff will, however, often succeed in both varieties. Another effectual stimulant is faradisation. It may be applied to a limb or to the cervical spine. The current should be gentle at first, and gradually increased. Emetics are also useful in arresting an attack. Injections of tartar emetic into the veins have been used with success by Calvi, but can hardly be recommended. The writer has found subcutaneous injection of apomorphine, $\frac{1}{20}$ to $\frac{1}{12}$ of a grain, an efficient remedy for similar paroxysmal conditions; with the onset of nausea, about five minutes after the injection, consciousness is regained, and all spasm ceases. In the intervals between the attacks the treatment is that of hysteria. Iron, antispasmodics, especially valerian, aloetic aperients, and cold baths, are the most effectual measures. Firm moral treatment is also indispensable. Removal from home influences is often necessary to effect a cure.

W. R. Gowers.

CATAMENIA, Disorders of.—*See* Menstruation, Disorders of.

CATAPLASM (*κατὰ*, down; and *πλάσσω*, I mould or smear).—A synonym for a poultice. *See* Poultice.

CATARACT.—Derivation and Synonyms.—Earlier Greek: *γλαύκωσις* (Hippoc.), *γλαύκωμα* (Aristot.); Later: *ὑπόχυμα* and *ὑπόχυσις*; Latin: *Suffusio* (Celsus); Arabic: *elmâ ennâzil* (descended water or humour); Mediæval Latin translators, *Aqua in oculum descendens*; *Descensus Aquæ*; also *Cataracta* (allied to Greek *καταρράκτης*), used at first in the sense of an obstruction or obstacle, like a floodgate, a portcullis, an obscuration such as that of the sun by a cloud. Fr. *Cataracte*; Ger. *Staar*.

Definition.—Cataract is an opacity, partial or complete, of the substance of the crystalline lens, or of its capsule. The former is called *lenticular*, the latter *capsular*. Either may exist separately, or the two may occur together, to form *capsulo-lenticular*. From a surgical point of view it is sometimes necessary to embrace within the definition of cataract some extra-capsular opacities, such as inflammatory deposits, or the remains of embryonic structures within the pupillary area of the anterior or of the posterior layer of the capsule. Such opacities are called *false* cataracts.

Anatomy and Physiology.—The nature and origin of cataract can only be made intelligible by reference to the anatomy, embryology, and physiology of the crystalline lens.

Anatomy.—The lens consists of three parts: first, the substance of the lens, which is made up of fine, flattened fibres; second, a layer of endothelium lining the anterior part of the capsule; and, third, the capsule, which, as a bag, surrounds and encloses the lens-substance and the endothelium. The fibrous portion of the lens consists of a harder, central part, or *nucleus*, and a softer external portion, or *cortex*. The cortex is disposed around the nucleus in thin, concentric layers, each of which is subdivided into sectors. Within the sectors the fibres lie with their ends at the edges of the sectors, and each sector has two of its edges towards the anterior, and two towards the posterior surfaces of the lens. The apposition of the edges of the adjoining sectors leaves fine radiating fissures, which make up the rays of the stella existing at the anterior as well as at the posterior surface of the lens. The fibres of the lens are softest at their ends, where they abut on the rays of the stellæ. The endothelium consists of a single layer of nucleated and nucleolated cells, and is usually limited to the anterior capsule. Towards the margin or *equator* of the lens these cells accumulate, elongate, and become gradually transformed into lens-fibres. Fine channels, occupied by lymph and other fluids, exist between the endothelium and the capsule, and between the endothelium and the anterior layers of the cortex, passing thence through the rays of the stellæ into the substance of the lens and between its several layers. The capsule, which is elastic and transparent, consists of two layers, a delicate inner one and a stronger outer one, which is further strengthened by prolongations of the suspensory ligament—the zonula of Zinn.

Embryology.—The ancestry and mode of origin of the several parts of the lens determine the peculiarities not only of the normal nutrition of the lens, but also of its pathological departures. The lens-fibres and the endothelium are descended from the external layer of the blastoderm—the epiblast, and are, therefore, immediately related to the cuticular tissues, including the enamel of the teeth and the epithelium of the sense-organs, and more remotely to the cerebro-spinal system. As will be seen later, this common origin from a primitive stock of epiblastic elements throws light upon many of the pathological associations of congenital and other cataracts. According to recent researches, the capsule of the lens seems to have a double origin, the inner layer being derived by a process of cuticularisation from the lens-substance, while the outer is the offspring of the mesoblastic elements from which the fœtal capsulo-pupillary sac, the vitreous, choroid, and intra-ocular blood-vessels are derived. Hereby the capsule is in direct histogenic relations with the bones, muscles, blood-vessels, and other fibro-vascular tissues derived from the middle layer of the blastoderm. These relations may also determine pathological manifestations in the capsule, and through its intermedium within the lens-substance itself.

Growth.—The fœtal crystalline lens is somewhat globular in shape, and its fibres have an antero-posterior disposition. But during later intra-uterine life, and still more after birth, the lens alters its shape, becoming broader and relatively flatter. It grows by the apposition of lens-fibres upon the nucleus, chiefly about the equator. The fibres themselves are derived from the endothelial cells lining the anterior capsule. These cells proliferate and gradually shift towards the equator, where they accumulate, and, as already stated, become transformed into fibres. The fibres bend round the equator, and spread out in front and behind, so as gradually to encase and push towards the centre the older underlying layers. The growth of the lens continues throughout life, and does not, in health, cease with the attainment of adult life. Priestley Smith has found that the volume of the lens increases through life at the rate of about 1·5 cubic mm. each year (*Trans. Ophthal. Soc.*, vol. iii. p. 79).

Nutrition.—The crystalline lens, being a non-vascular body, is nourished by imbibition from surrounding fluids, which are chiefly furnished by the ciliary body, though this source is supplemented by contributions from the choroid, the iris, and perhaps the retina. It is probable that these fluids are modified by their passage through the vitreous. It is not known exactly how or where these fluids gain access to the lens-substance, but it is evident that they pass through the capsule, and that in the passage they undergo some alteration; for if the anterior or the posterior capsule be ruptured, the lens becomes opaque. The surrounding fluids then come into immediate contact with the fibres of the lens, and being unmodified by the dialytic properties of the capsule, or the elaborating influences of the endothelium, they are unsuited for the purposes of normal nutrition. In health, after the nutritive fluids have made their way through the capsule, they pass from the periphery to the centre through the stellate clefts and other channels which exist throughout the lens. In this respect the lens differs from other cuticular structures, in which waste products are shed from the surface; while in the lens waste products are apparently driven inwards to the centre, to undergo elimination in a manner not yet fully understood.

The nutritive activity of the lens, as manifested by the number of nuclei, is apparently greatest at the equator, and it is at this point, between the layers of the suspensory ligament, that the capsule is in most immediate contact with the ambient fluids. Many authorities believe that the nutritive fluids enter the lens chiefly, if not entirely, at this place, and that this region is the principal seat of cell-growth. There are, however, reasons for thinking that neither endosmosis nor cell-proliferation is most active here. In some diseases of the choroid or of the retina on the one hand, and of the iris or of the cornea on the other, opacities of the lens first manifest themselves not at the equator, but at the posterior or the anterior surface respectively, that is at that part of the lens which is *nearest* to the diseased structures, and which bears the brunt of the morbidly altered fluids. A typical example is the formation of posterior polar or stellar cataract in retinitis pigmentosa. Moreover, microscopical examinations of cataractous lenses often disclose proliferation and accumulation of nuclei behind the anterior capsule, and even within the posterior capsule, without corresponding increase at the equator.

Beyond increasing in size, the lens does not, in health, undergo much change till after middle life. Thenceforth the fibres gradually assume a yellowish or brownish tint, and the rate of formation of new fibres diminishes. As age advances the fibres become drier, harder, and less elastic, and the capsule thickens. If a senile lens be ophthalmoscopically examined with a strong magnifying-glass, semi-translucent lines, flaws, spaces, and vacuoles, and fine, dusty films, may often be discovered, even when there are no coarse physical opacities. These phenomena are due to shrinking of the lens-fibres and loosening of the lamellæ from one another, with accumulation of fluid and lens-débris in the spaces thus formed. Still later, separation of the cortex may take place, both from the nucleus and from the capsule. The separation from the capsule is, as Becker has shown, especially liable to occur at that part of the capsule which is most acted upon by the suspensory ligament during accommodation. Increase and extension of the changes eventuate in opacity, and the occurrence of senile cataract. These senile changes have their analogues in the skin and its appendages. The skin of old people is wrinkled, the cuticle becomes dry and harsh and shrivelled, and the hair thin and white.

PATHOLOGY.—A lens of good ancestry and of good constitution continues to be transparent so long as the conditions and processes of nutrition are normal; but any fault in the original constitution of the lens, or any defect in the embryonic process, or any alteration in its nutrition at any subsequent period, will, sooner or later, and in proportion to the degree of divergence from the healthy standard, induce opacity of some portion of the lens or of its capsule.

The chief *embryonic* abnormalities are (1) inherent faults of the epiblastic cells which constitute the rudimentary lens. The fibro-cellular portions of the lens fail to undergo proper evolution, and either do not become transparent, or, if they do clear, their potentiality is low, and they soon retrograde. The lens is often undergrown as well as opaque, and is not infrequently malposed. Sometimes the eyeball itself is small (*microphthalmia*). Even if the lens do attain its natural proportions, the new cortical substance is generally of inferior quality, because the endothelium, which furnishes the cortical substance, shares the same faults as the nucleus itself. Hence the whole lens is either opaque from the beginning (*congenital cataract*), or becomes opaque within a few months or years (*infantile* or *juvenile cataract*). (2) Owing to causes which may be peculiar to the lens, or which may affect the whole of the growing organism, or which may operate indirectly through so-called maternal influences, a temporary or permanent disturbance may occur during intra-uterine life to thwart the development of a lens. If the interference be violent its effects may be permanent, so that the whole of the lens becomes opaque, even though it may continue to increase in bulk. If the check be of a temporary character, only a thin layer of opacity may be produced: natural development re-asserts itself, and transparent cortical fibres are produced in the ordinary way. The nucleus of the lens, though not unaltered, is usually translucent and the cortex transparent; but the intermediate layers—that is, the sub-cortical or perinuclear—are more or less opaque. This form of opacity is called *lamellar* cataract, because in sagittal section it is seen to be disposed in layers around the nucleus; or *zonular* cataract, because the opaque portions, when looked at *en face*, are bordered by a transparent zone of clear cortex. It would seem that the layers which are opaque are either those which were immediately sub-capsular at the time when the disturbance took place, or those which were produced by the endothelial cells during the period of disturbance. On this assumption the position of the opacity may be regarded as indicating the time at which the interruption took place. The earlier the interference the nearer will the opacity be to the nucleus of the lens, and *vice versâ*. In some rare cases there are two or more concentric layers of opacity, with intervening layers of clear substance, as if there had been several disturbances at different epochs, followed by intervals of normal growth. Lamellar cataracts may be found in eyes otherwise healthy, but they are sometimes associated with developmental defects of the eye and of the general organism, an almost invariable concomitant being deficiency of enamel of the permanent teeth, especially the first molars, the incisors, and the canines (Hutchinson), and not infrequently there is a clinical history of 'fits,' or other evidences of a neurosis. (3) As the result of inflammation of the cornea, uveal tract, or vitreous during intra-uterine life, single or multiple opacities may form in the capsule and sub-capsular layer. These are called *congenital capsular* cataracts, and are most common at the anterior pole. They may, however, be scattered about the anterior surface, or lie about the posterior pole of the lens. These opacities consist of proliferation of the endothelium and granular disintegration of the superficial cortical layers, similar to those changes which produce capsular and sub-capsular opacities after birth. It is, however, not improbable that congenital anterior polar cataracts may sometimes be due, not to inflammation, but to retarded separation of the involuted lens-vesicle from the cornea, and delayed closure of the vesicle. This retardation may permit of the intrusion of mesoblastic elements within the vesicle, and these would still further increase the opacity about the capsule. This may conceivably cause an axial opacity, the so-called *spindle-shaped* cataract. (4) *Congenital false* cataracts may be due to the presence of extra-capsular opacities upon the anterior or the posterior pupillary areas. These opacities may be the results of inflammatory exudations, but more commonly they are due to an arrest of development in its final stage. The development and growth of the lens may have been normal up to the stage at which the removal of the embryonic capsulo-pupillary sac should have taken place, but, having ceased immediately before the removal was complete, portions of the fœtal structures remain. When these are on the anterior surface, they are connected with the edge of the iris, or more frequently with its anterior surface; when on the posterior surface of the lens, the remnant may be connected with a fine thread which is itself the remains of the hyaloid blood-vessels. This state of incompleteness may be designated by the Aristotelian term *Ateleia* (*Physic*, viii. 9; *De Animal. Gen.* iii. 9).

The alterations in nutrition which, *after birth*, lead to the formation of cataract may be classified as follows:—

(1) *Diminution in the quantity* of the nutrient elements, without material alteration in their quality. This diminution may be due to many causes: (*a*) mechanical obstacles impeding due access of the fluids; (*b*) damage to the secretory apparatus consequent upon chronic atrophy of the ciliary body and choroid; (*c*) general malnutrition, cachexia, anæmia, cardiac, renal, or other visceral disease; or (*d*) simple old age.

Mere diminution of the quantity of nutritive elements operates slowly on the nutrition of the lens, and the opacity which results manifests itself in or about the nucleus—that is to say, the parts most remote from the sources of the nutrient fluids. The cortex seems to receive enough pabulum to keep it clear, but not enough to spare for the support of the deeper layers.

(2) *Alterations in the quality* of the nutrient elements. These may be due to: (*a*) congestion, inflammation, or any other morbid state of the secretory organs of the nutritive fluids—namely, the ciliary body, iris, choroid, and retina; (*b*) changes in the vitreous or in the aqueous humour; (*c*) morbid states of the blood and tissues, as in many general and diathetic diseases—gout, glycosuria, albuminuria, &c.; (*d*) changes in the physical, chemical, or vital properties of the capsule or of its endothelium, in consequence of which the fluids that pass through the capsule are not properly prepared for the due nutrition of the lens; or (*e*) impeded elimination of waste products, whether from the lens itself or from the whole eyeball.

Alterations in the quality of the nutrient elements are more or less prompt—and if the alteration be very great, as, say, in rupture of the capsule—they are very prompt in producing opacities. The opacities which result affect primarily the sub-capsular and the cortical layers, more particularly at the ends of the fibres adjoining the rays of the crystalline stellæ where the endosmotic processes are most active, and where the effect of the altered quality of the fluids is first apparent. The affected parts are those with which the altered fluids first come into contact, and which lie therefore nearest to the sources of the altered fluid. If the alteration be intense, but of brief duration, as in the case of perforating ulcer of the cornea in purulent ophthalmia of children, the change may be limited to a circumscribed area of the capsule and sub-capsular layers, giving rise to an *anterior polar* cataract, or, if this opacity assume a conical shape, *anterior pyramidal* cataract. In alterations of less intensity, but of continuous duration, due to chronic morbid states in the posterior segment of the globe, such as retinitis pigmentosa, slowly forming opacities may occur in the posterior sub-capsular layers of the lens, beginning at the pole of the lens, and extending thence in a radial direction along the rays of the posterior stella, giving rise to *posterior polar* or *stellar* cataracts.

(3) *Alterations of quantity and quality combined.* This co-operation obtains in most of the cases of cataract; diminution of quantity being the chief factor in some, alterations in quality predominating in others. Where the departure from the normal approaches most closely to mere diminution in quantity, the onset and progress of the cataract is slower, and the opacity tends to affect at first the parts nearer the centre of the lens; but where the alteration in quality is pronounced, the onset and progress are more rapid, and the opacity begins in the cortex. It will easily be understood that the great majority of cataracts are cortical, because there are comparatively very few cases, even in apparently healthy eyes, where the alteration in nutrition does not exhibit some difference in the quality of the nutrient elements, as well as falling off in quantity.

Morbid Anatomy.—The changes which take place in cataract are not the same in all cases. There is, for example, a great difference between the changes which produce some embryonic cataracts and those which give rise to acquired cataracts, and between those which produce lenticular cataract and those which give rise to capsular cataract. Indeed capsular opacities are often secondary to lenticular. Even in true lenticular cataract the morbid changes are many and various. In senile cataracts, and in most slowly forming cataracts, the opacity of the lens-fibres is merely an extension of physiological senile changes, and is usually preceded by the formation of spaces and vacuoles between the fibres and the lamellæ due to shrinkage and sclerosis, as already described. Priestley Smith's investigations have shown that a diminished rate of growth of the lens precedes cataract (*op. cit.*). According to Otto Becker the initial cause of senile cataract is the drying of the nucleus and its separation from the cortex, the gap between them being filled by a fluid which is probably derived from the fibres. In more rapidly forming cortical cataracts it may often be observed that the opacity begins in the sub-capsular layers and about the borders of the rays of the anterior stella. Instead of shrinkage and sclerosis, the fibres may swell and become softer. In some cases the rays of the stella are broadened, but whether they are or not, a hazy line may often be traced along one or both of the edges of the ray, in the ends of the cortical fibres. From the ends of the fibres the opacity extends along their lengths towards the equator, until the whole of the cortex is implicated. The endothelium also undergoes changes, giving rise to triangular patches of glistening opacities which may present a mother-of-pearl appearance. When once the opacifying process begins in any part of the lens it tends to progress till the whole of the lens is involved. The cataract is then said to be *ripe* or *mature*.

If a ripe cataract be allowed to remain within the eye indefinitely, it may undergo further degenerative changes and become what is called *over-ripe*. In some instances the lens-substance shrinks and becomes hard and calcareous, and the capsule thickens and grows more opaque. In other cases the cortex liquefies, allowing the harder nucleus to move within it (*Morgagnian* cataract). In calcification of the lens the process begins in the external cortical layers, and it may ultimately affect the entire thickness of the lens. Calcification is more liable to occur in cataracts due to gross disease of the eye, and especially when there is an inflammatory exudation upon the capsule. Short of general calcification, minute white dots, lines, and patches may appear in the capsular endothelium of mature cataracts. Over-ripe cataracts may also become loosened, in consequence of softening or rupture of the suspensory ligament. Fluidity of the surrounding vitreous may likewise occur, and then on slight provocation the loosened lens may fall into the vitreous.

A peculiar form of degeneration sometimes occurs in the lens, producing what is called *black* cataract. This is commonly thought to be due to the staining of the lens by blood-pigments, and in some cases this may be so; but, according to a careful spectroscopic examination by Dr. McMunn, no blood-pigments were found, but the lens was infiltrated with a pigment analogous to melanin, which is the pigment of hair and feathers (*Trans. Ophth. Soc.* vol. ii. p. 10).

Ætiology.—Besides the causes and conditions already described, there are other circumstances which may induce cataract, or at least predispose to it. The most important of these are as follows:—

Age.—Cataracts occur more frequently in infancy and in old age than in early adult and middle life, except when due to disease of the eye or to injuries. *Sex.*—The two sexes are about equally affected, except in respect of traumatic cataract, in which males greatly preponderate. *Heredity.*—Hereditary influences may determine the occurrence of cataract in several ways. There may be the inheritance of actual (congenital) cataract or of a disposition to cataract. In either case the descent seems to pass more through the male than the female line. *Occupation.*—Certain occupations predispose to cataract, especially such as necessitate close application of the eyes to near work, or involve stooping positions or exposure to bright light, more particularly if light be combined with heat (as in the occupation of smiths, cooks, stokers, &c.), and occupations in which the eyes are exposed to irritating fumes and vapours. Uncorrected *errors of refraction* and accommodation may favour the production of cataract by overstraining the accommodation, and by the frequent and successive changes which the capsule has to undergo. These strains not only increase the wear and tear of the lens, but facilitate the loosening of the cortex of the lens from the capsule. Hypermetropia and astigmatism may predispose to cataract in another way. The incessant strain upon the ciliary muscle required to correct hypermetropia involves constant congestion of the ciliary body and the base of the iris. The nutritive fluids secreted during this state are not perfectly normal; they are in some measure altered in quality and will therefore sooner or later make their influence felt on the transparency of the lens. *Injuries.*—Wounds of the capsule are generally soon followed by opacity, which occurs more quickly in proportion to the size of the rent and the youth of the patient. Perforating wounds of the cornea, especially when followed by suppuration, may induce cataract even though the capsule have not been perforated. Blows on the head, face, or brow, shocks and jars of the body, may also be followed by cataract, either from causing flaws or cracks or rents in the capsule or by rupture of the suspensory ligament. Other conditions which accompany and apparently predispose to cataract are degenerative changes in the blood-vessels, especially of those of the head and neck and of the eye; diseases of the orbit, or changes in the orbital vessels; cardiac disease, renal disease, gout, and diabetes. It is probable, however, that the influence of diabetes in the production of cataract has been overrated. The number of diabetic persons who get cataract is comparatively small, and when cataract coexists with glycosuria there is no necessary causal relationship between the two. It has been stated that ergotism often leads to cataract (J. Meyer).

Classification. — Cataracts have been classified in many ways, as (1) according to *age*—congenital, juvenile, senile; (2) to *stage*—incipient, progressive, stationary, immature, mature; (3) *consistency*—fluid, soft, hard, and mixed.

All these plans possess some clinical utility, but they are not sufficiently comprehensive. Following the indications afforded by the consideration of the pathology and causation of lenticular opacities, cataracts may be arranged into five main groups according (1) as they are due to developmental abnormalities—*embryonic*; (2) as they occur independently of obvious disease of the eye—*idiopathic*; (3) as they are associated with obvious disease of the eye—*sympathetic*; (4) as they follow wounds or injuries of the eye—*traumatic*; and lastly (5) as they are due to the opacification of lens-matter remaining within or on the capsule at the time of operation for the removal of cataract, or of lens-matter which may have grown subsequently and then become opaque—*deuteropathic* or subsequent (δευτεροπαθέω, I suffer later.—Galen, *De Loc. Affect.* i., iii. ed. Kühn viii. 31). Within one or other of these groups all the varieties of cataract may be arranged according as they implicate (1) the nucleus; (2) the perinuclear region (lamellar); (3) the axis (spindle-shaped); (4) the cortex, anterior or posterior; (5) the equator; (6) the capsule, anterior or posterior; (7) the external surface of the capsule—extra-capsular—which may be congenital or acquired.

Symptoms.—The chief subjective symptom of senile and other acquired cataracts is impairment and 'fogginess' of sight, especially for distant objects. As the cataract advances, this dimness increases, until the appreciation of form and colour may be lost; but, in eyes otherwise healthy, the power of discerning light always remains, even though the lens be quite opaque. In ordinary daylight the eye may still be able to 'count fingers' at a distance of six to twelve inches, or see the movement of, say, a hand at a distance of twelve to eighteen inches (hand-movement); and in a darkened room the eye should be able not only to see a lighted candle at a distance of ten to fifteen feet, but should be able also quickly to indicate its position in various parts of the field of vision without movement of the eyes or head. This would indicate that there is good *perception* of light, good *projection*, and a good *field of vision*. In the early stages of cataract, especially when the opacity occupies the pupillary area, patients may see better when the eyes are shaded, the pupil being thereby made to dilate; a bright light embarrasses and distresses them. Muscæ volitantes are also often seen; these may be due to the congestion of the ciliary body and choroid which may have preceded cataract, or they may be the results of the straining efforts to see through a hazy lens. Another common symptom is the multiplying or splitting of objects, especially of lights (monophthalmic polyopia). The amount of impairment of sight is not always in proportion to the amount of appreciable opacity; diffused haziness about the nucleus or about the pupillary area is more hampering than well-defined striæ or sectors with clear interspaces. There may be dense opacities at the equator with perfect acuteness of vision. An occasional early symptom of cataract is a change in the refraction of the eye, leading to what some persons describe as getting 'the second sight.' Eyes that have required strong convex glasses for near work prefer weaker ones, or none at all; and those who have needed convex glasses for distance may find that they see better without them, or even with concave glasses. This is a passing state, though it may last for weeks and even for months; it is due either to the swelling of the lens or to some change in its refractive index. After a time this condition passes off and is followed by progressive failure of sight. Many children with zonular cataract are thought to be merely short-sighted, and often they are short-sighted, but the true cause of the defect is frequently not discovered till the 'optician' has failed to get good vision by means of spectacles.

Diagnosis.—In all cases of failing sight, whether opacities are to be seen or not by means of direct light or by so-called focal or oblique illumination, the media of the eye should be examined with the ophthalmoscope. Owing to thickening of the lens-capsule, the pupils of old persons are sometimes grey instead of black, and the lenses may seem to be opaque when they are not really so; and in glaucomatous eyes the change of colour which takes place in the cornea and in the lens not infrequently suggests cataract even when the media are translucent. Diagnosis of advanced cataract is easy, but in slighter cases careful examination of all parts of the lens may be needed. The aims of diagnosis are to recognise the presence of the cataract, to ascertain its seat, extent consistence, and its relations or complications, and to discriminate it from other morbid states which may be mistaken for it. Examination of the anterior part of the lens, the capsule, anterior cortex, and the nucleus may be made with 'focal illumination,' that is concentrating light upon the eye by means of a magnifying-glass. The equator of the lens and the posterior cortex require the ophthalmoscope for their examination. Opacities which seem white or greyish by focal illumination appear black against the red ground of the fundus-reflex when looked at with the ophthalmoscope. The different parts of the lens should be examined methodically, beginning with the anterior capsule and passing through the thickness of the lens to the posterior capsule.

Anterior extra-capsular opacities, whether inflammatory deposits or remains of the capsulo-pupillary membrane, project beyond the level of the capsule. The latter have usually attachments to the anterior surface of the iris (*circulus minor*), whereby they are distinguished from inflammatory adhesions (posterior synechiæ) which are connected with the edge and posterior surface of the iris. Capsular cataracts may be single or multiple. Anterior polar cataract occurs as a small circumscribed dot in and behind the centre of the capsule; when viewed in profile the dot can be seen to project slightly beyond the general level of the capsule; occasionally it projects considerably and is conical (pyramidal cataract). Both these cataracts are generally associated with nebula or leucoma of the cornea. Multiple capsular opacities may be scattered irregularly or arrayed in a circle. Cortical opacities assume many shapes—striæ, wedges, or irregular patches. When the opacities are in the anterior cortex, they are convex in their arrangement; when in the posterior they are concave. Equatorial opacities may be partial or complete, continuous or interrupted, limited as a corona to the periphery, or send tapering offshoots towards the anterior and posterior cortices. Perinuclear opacities may be circumscribed or diffused. The circumscribed (lamellar or zonular cataracts) are best seen with the ophthalmoscope when the pupil has been dilated by a weak solution of atropine or other mydriatic. Lamellar cataract appears as a greyish disk surrounded by a clear zone. If the nucleus be translucent the disk is most opaque at its edge; but if the nucleus be itself opaque, then the opacity is densest in the centre. The edge of the disk may be sharply defined, or indented or broken by centrifugal striæ. Nuclear opacities may be dense and diffuse, as in some congenital cataracts, or they may appear as a brownish or yellowish undefined blur or cloud, as in early senile cataract. Posterior polar cataract can be properly seen only with the ophthalmoscope. It may assume the form of a smaller or larger dot, or of several dots, or of radiating streaks. The position of the opacity is determined partly by its remoteness from the pupil, and partly by the small excursions it makes in the various movements of the eye, the posterior pole of the lens being immediately in front of the centre of rotation of the globe. Posterior polar cataract may be congenital, but more commonly it is pathological and associated with opacities in the vitreous or with disease of the choroid or retina.

Whenever practicable, it is desirable in all forms of cataract to examine the state of the optic nerve and fundus of the eye. The data thereby obtained may influence the prognosis and the later treatment. When the cataract is mature the pupil is uniformly white or greyish, and the opacity comes up to and seems to touch the pupillary edge of the iris, and no reflex can be obtained by means of the ophthalmoscope. If the cortical layers are not opaque, a shadow of the iris can be thrown into the lens by means of oblique illumination, giving the appearance of a gap between the opacity and the edge of the iris. For surgical purposes it is not necessary that the whole of the lens-substance should be opaque; it is enough that the cortical layers be opaque, for then the connexion between the cortex and the capsule is broken, and the endothelial cells have lost their power of growing fresh lens-fibres. It is not always possible to estimate the consistency of a cataract; but, as a rule, cataracts which begin in the cortex, or occur in persons under the age of thirty years, or are rapidly formed, are usually 'soft'; such cataracts are generally whiter and more opaque than harder ones, and the opacity is often patchy or diffused. Nuclear cataracts, and those which occur in old persons, or are of slow formation, or yellowish in colour, or in which the lenses are small and shrunken, or which have small, well-defined opaque striæ with clear interspaces, are usually 'hard.'

The failing sight of chronic glaucoma is sometimes ascribed to cataract. This mistake is fostered by a superficial resemblance between these two conditions. By the ophthalmoscope and by palpation, the error may easily be avoided. When the lens is not opaque in glaucoma the diagnosis is simple, mere absence of opacity excluding cataract; but when, in glaucoma, the lens is also opaque, the diagnosis may present some difficulty. In chronic glaucoma the characteristic symptom is increased hardness of the eyeball. Usually a history of haloes seen round artificial light may be elicited, with perhaps attacks of neuralgia and redness of the eye. The pupils are semi-dilated and very sluggish, if not immobile, and the anterior chamber is shallow, and the sight is more impaired than the cataract accounts for. In advanced (absolute) glaucoma there is an entire abolition of the perception of light.

Prognosis.—Cataract may be considered, as regards its prognosis, from two points of view: first, when it is immature, as to its probable course; and, secondly, when it is mature, as to the prospects of recovery of sight after operation. Some cataracts may remain stationary throughout a long life: such are anterior polar, anterior pyramidal, and zonular cataracts. Others progress slowly, such as posterior polar cataracts. Cortical cataracts, as a rule, advance more rapidly than nuclear ones, and soft cataracts more rapidly than hard. It is not possible in all cases to decide whether a cataract is likely to progress slowly or quickly. Generally the progress is quicker the earlier the cataract occurs, and the closer its association with morbid states of the eye or with injury. When cataracts are sharply defined, confined to the equator of the lens, or present only a haze or blur in or about the nucleus, or when the cortical striæ are few and fine and well-defined, with clear interspaces, and the eyes are otherwise healthy, and the sight good, the progress will usually be slow; but when the opacities are dense, irregular, ill-defined, diffuse, especially where they extend far along the anterior or posterior cortical layers, with rapidly failing sight, or with sight bad out of all proportion to the amount of actual opacity, or when there is obvious irritative or inflammatory disease of the eye, or when there is grave visceral or other constitutional disease, such as gout, diabetes, nephritis, then the progress will probably be rapid. But it should be remembered that cataracts which may have been very slowly progressing may at any time take a sudden and rapid start and progress quickly. The usual course, in senile cataract, is from one to four years or more.

As regards *mature* cataract, the prognosis in reference to operation is good in proportion as the eye is otherwise sound, and the general health good. Where there is a history of attacks of pain or of redness in the eye, or where there are signs of past disease, whether iritis or choroiditis or retinitis, or where there is a high degree of myopia, or where the iris is discoloured and lustreless, and sluggish or immobile, or where it is tremulous, or where the anterior chamber is much deeper than natural or much shallower, or where there is a chronic conjunctivitis, ciliary blepharitis, or catarrh of the lacrymal sac, or where the tension of the eye is too high or too low, the prognosis is more or less unfavourable. Nystagmus, squint—especially divergent squint—are unfavourable concomitants; and the prognosis is, of course, less favourable when it is known that there was antecedent disease of the fundus, or when, failing this knowledge, the perception of light is poor, and the projection bad, and the field of vision contracted or irregular. Where there is no perception of light, the prognosis is hopeless.

TREATMENT.—From a medical standpoint, the treatment of cataract is rather preventive and palliative than operative.

Prevention.—From a consideration of the causes and pathology of cataract, it is evident that, while some cases are beyond the reach of prophylactics, there are others which do fall within the category of preventible diseases. In the present state of knowledge and therapeutical art, little can be done, directly, to prevent many of the embryonic forms of cataract, and those other cataracts which are due to simple diminution of the *quantity* of nutrition, of which pure senile cataract is the type. Our control over the processes of development and of senile decay is, at best, slight and limited. On the other hand, it is at least ideally possible to prevent the occurrence of many of those cataracts which are due to alterations of *quality* of nutrition. By the prevention or the avoidance of those general and local conditions and morbid states which induce these qualitative alterations, or by their early and effectual treatment, *secundum artem*, by obedience to the laws of personal and public hygiene, by conforming to the requirements of healthy sight, by the scientific correction of errors of refraction and accommodation, by adequate protection of the eyes during those occupations which entail risks of phsyical, thermic, or chemical injuries, cataract may often be prevented, or its progress arrested, if perchance initial changes have already begun. For the prevention of cataract, as well as in its general treatment, the twofold origin of the lens-substance and its capsule should be borne in mind. The fibres and the endothelium of the lens, and the inner layer of the capsule, being epiblastic in origin, are in intimate relationship with the central nervous system, the cuticle, hair, nails, enamel of the teeth, and other tissues derived from the external layer of the blastoderm, and are, therefore, apt to participate in many of their pathological states. Similarly, by its mesoblastic origin, the external layer of the capsule is directly related to the bones, muscles, blood-vessels, and other fibro-vascular tissues, and is liable to their affections. In these affections the lens-fibres and the endothelium may become secondarily involved. Whatever promotes the nutrition, or averts breakdown, or arrests or cures disease, of one portion of these groups of tissue-elements, will, presumably, in some degree influence other portions. Hence general principles are capable of a particular application to the several parts of the lens and its capsule. It should, however, be borne in mind that though the epiblastic and the mesoblastic portions of the lens have their proper constitution and peculiar modes of activity, they are nourished by fluids chiefly, if not exclusively, furnished by the ciliary body and other parts of the uveal tract.

Palliation.—If opacity of the lens exists, but not to an amount sufficient to materially impair sight, it is sometimes possible, by general and local measures, to improve the special nutrition of the lens, and thereby to retard the progress of the cataract. In some cases, where slight endothelial and cortical opacities occur during transitory inflammation of the cornea, iris, or choroid, or during exacerbations of diabetes and other diathetic diseases, the opacities may gradually disappear on the resumption of normal nutrition after the subsidence of the inflammation or the melioration of the general health. But, except within these narrow limits, genuine cataractous opacities are incurable and irremovable by any means known to positive science other than operation. Notwithstanding the advancement of medical knowledge and the increased resources of surgical art, the earliest dictum recorded in medical literature respecting the curability of cataract still holds good. Nearly nineteen hundred years ago Celsus remarked: 'Cum [suffusio] recens incidit, medicamentis quoque sæpe discutitur; sed ubi vetustior facta est, manus curationem desiderat' (*De Medicina*, vii. 7, 13). Increased knowledge of the nature of cataract lessens rather than increases the hope and expectation of dispersing the opacity by local applications or internal medicaments; indeed it tends more and more to demonstrate the futility of such pretensions and attempts.

Nevertheless the inconveniences which attend progressing cataract may be palliated by alleviating local irritation, by the use of tinted glasses, by shading the eyes from bright light, by correction of optical errors, or by the use of stenopæic glasses. When the opacity, whether congenital or acquired, is limited to the pupillary area of the lens, vision may be improved by moderate dilatation of the pupil, by means of weak solutions of atropine (gr. $\frac{1}{20}$ to gr. $\frac{1}{6}$ in an ounce of water), or other mydriatic. In any case, if the eyes be otherwise healthy, moderate use of the eyes may be indulged in, short of discomfort and fatigue.

Operations.—The operations for the cure of cataract may, with some allowance made for differences of local conditions, be compared with the three procedures employed for the removal of vesical calculus—namely, simple crushing, with escape of the fragments *per vias naturales*—lithotrity; crushing with instant removal of the fragments by aspiration—litholapaxy; and, lastly, extraction of the calculus *en masse*—lithotomy. The corresponding operations for cataract are: First, *discission*, or *keratonyxis* (κέρας, horn [cornea]; νύσσω, I prick), in which the anterior capsule is torn by a fine needle passed through the cornea. The lens-substance, being thereby exposed to the disintegrating action of the aqueous humour, gradually liquefies and is ultimately eliminated by the absorbent vessels. Secondly, *discission* with *evacuation*. The capsule is torn as in discission, but the lens is more freely broken up. The fragments are then, or within a few days, removed by a grooved curette through a narrow incision immediately within the corneal margin (linear extraction), or withdrawn by aspiration through a fine tube (suction). The third operation is *extraction*, in which an incision is made at or near the corneal margin, the capsule divided and the lens extruded by gentle pressure. Until quite recently a portion of the iris was in the modern operation removed (iridectomy) at the time of the extraction-operation, or a few weeks or months previously (preliminary iridectomy). But some surgeons now try to dispense with the iridectomy, or only do it when the cataract cannot otherwise be safely and efficiently removed. The first and second of the operations above referred to are applicable to 'soft' cataracts, while extraction is usually reserved for 'hard' cataracts. Soft cataracts may be operated on almost at any time and in any stage; but hard cataracts are, as a rule, not extracted until they are 'mature,' though there are many circumstances which may suggest and justify departure from this rule. An immature cataract may be operated on whenever both eyes are so affected that the patient is unable to read ordinary print or to follow his occupation or profession.

It may here be remarked that when zonular cataract is slight, and does not cause appreciable impairment of sight, operation may be indefinitely deferred. If, on the other hand, the opacity is more pronounced, and the degree of impairment of vision is such that education or occupation cannot be comfortably pursued, operative interference is called for. The precise procedure will depend upon circumstances. If the cataract be small, dense, with defined margins and surrounded by a broad clear zone, a small iridectomy downwards and inwards (artificial pupil) may suffice to give useful vision; but if it be large, and not very opaque, or if its edges be ill-defined and broken by projecting striæ, and the surrounding zone narrow and hazy, then discission, with or without evacuation, will be indicated.

When the eye has recovered from the effects of the operation, spectacle-lenses are needed to correct the error of refraction due to the absence of the crystalline (*aphakia chirurgica*). Except in very short-sighted eyes convex lenses are required. The strength of the lens will depend upon the refraction of the eye, but ordinarily for distance a lens of about 10 dioptres (4-inch) is needed, and for near work about 14 D. ($2\frac{3}{4}$-inch). If astigmatism (*see* VISION, Defects of) be present, then cylindrical lenses must be added to the sphericals. In any case, it is desirable that an eye which has been operated on should not be used too soon, nor, at first, for too long a time.

Sometimes it happens after the removal of a cataract that, owing to the presence of hazy or opaque lens-capsule within the pupil, it is not possible to obtain useful vision by the most accurate optical correction. It will then be necessary to tear through the membrane with one or two fine needles, and thereby effect a clear opening opposite the pupil.

JOHN TWEEDY.

CATARRH (*κατά*, down; and *ῥέω*, I flow). SYNON.: Coryza; *Catarrhus* (Cullen); *Catarrhus communis* (Good); *Rheuma*; Fr. *Catarrhe*; *Coryza*; Ger. *Katarrh*; *Schnupfen.*

DEFINITION.—The term catarrh is applied generally to inflammation or congestion of the mucous membranes, attended with increased secretion. Thus authors speak of *catarrh of the stomach, intestines, bladder, &c.* In the present article the term is limited to the inflammatory affections of the upper part of the air-passages, resulting from cold, and attended by discharge from the nostrils, soreness of the throat, hoarseness, and cough. The term coryza is, however, more especially limited to the cases in which there is copious discharge from the nasal passages, while catarrh is applied to affections of the whole mucous membrane, including the fauces and larynx.

SYMPTOMS.—The attack generally commences, shortly after exposure to cold or more particularly to cold and damp, with a feeling of indisposition, sense of cold down the back or general chilliness, weight in the forehead, headache, especially frontal, and dryness of the nares and throat. These symptoms are succeeded by the discharge from the nostrils of a thin acrid fluid, watering of the eyes, pains in the face, soreness of the throat and hoarseness, with aching in all parts of the body, and disinclination to bodily and mental exertion.

At first the affection is often confined to one nostril, and there is pain in the corresponding temple, eyebrow, eyeball, and side of the face, and lacrymation on that side; but it soon appears in the other nostril, and involves both eyes and all parts of the face; and there is great sense of weight and pain in the forehead and eyebrows. The discharge, also, loses the thin character and becomes mucous, and is often very profuse; there is copious lacrymation, the throat becomes decidedly sore, the hoarseness is greater, and there is pain in speaking and sometimes almost entire loss of voice. There are also transient pains in the chest, with a sense of tightness and some wheezing. The appetite from the first is impaired, and there may be entire distaste of food, and sometimes sickness and vomiting; not infrequently there is some sense of weight in the right hypochondrium, and sallowness of the complexion; the bowels are usually confined, but there may be diarrhœa. The tongue is generally white, the pulse may be a little quickened, the skin may be dry, the temperature is raised, and the urine is scanty and somewhat high-coloured, and deposits a little sediment. The pains in the head and face especially affect the forehead, the eyebrows, the root of the nose, the eyeballs, and the course of the dental and other nerves; they generally increase towards night, and may be so severe as entirely to prevent sleep. Not infrequently there is more or less deafness, and usually loss of smell and taste. Herpetic spots often appear about the mouth, and the nostrils may become ulcerated from the discharge; the throat is more or less red and swollen, and often there is stiffness and pain of the neck, and tenderness on pressure over the larynx.

After these symptoms have continued for two or three days they generally gradually subside; but the cough may continue troublesome, and the patient be able to take very little food, and may still feel weak for a week or more. In persons of delicate constitution, also, the weakness is often very persistent; and, if care be not taken, more serious inflammation of the bronchial mucous membrane or of the lungs may supervene, and may lapse into phthisis.

TREATMENT.—In the slighter forms of common cold but little treatment is required, except the use of the ordinary household remedies: the feet may be placed in hot water, some warm diluent beverage may be taken, and a light diet must be had recourse to for a day or two. In the more serious cases febrifuge medicines may be given, with an anodyne to relieve the cough, if troublesome, or to procure rest at night, if the neuralgic pains be very severe.[1] When the attack has continued for two or three days a more stimulating diet may be given, and during convalescence tonics and stimulants may be required.

Dr. Ferrier recommends in catarrh the local application to the nose of the following powder in the form of a snuff: Hydrochlorate of morphine 2 grains, subnitrate of bismuth 6 drachms, gum acacia in powder 2 drachms. From one-quarter to one-half of this may be taken in the course of twenty-four hours.

It not infrequently happens that in delicate persons a cold is very difficult to get rid of, and the slightest exposure is followed by an aggravation or renewal of the symptoms. When this is the case the most effectual remedy is change of air, and the patient after leaving home often rapidly improves, and soon gets well.

THOMAS B. PEACOCK.

CATARRHAL (*κατά*, down; and *ῥέω*, I flow).—Pertaining to catarrh, both in its pathological and clinical significations—for example, catarrhal products, catarrhal pneumonia, catarrhal fever, catarrhal attack.

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[1] From 20 to 60 minims of Spiritus Ammoniæ Aromaticus in a claret-glass of any effervescing water may be taken at bed-time or oftener with marked benefit.—EDITOR.

CATHARTICS (*καθαίρω*, I cleanse).—This word is sometimes used as a synonym for purgatives; but in a more limited signification it means purgatives of moderate activity. *See* PURGATIVES.

CAUSES of Disease.—*See* DISEASE, Causes of.

CAUSTICS (*καίω*, I burn).—DEFINITION. Substances or measures which destroy organic tissues with which they may be brought in contact.

ENUMERATION.—The caustic substances in most common use are Potash, Soda, and Lime; Nitric, Hydrochloric, Sulphuric, Chromic, Lactic, and Glacial Acetic Acids; Red Oxide, Acid Nitrate, and Perchloride of Mercury; Carbolic Acid; Chloride of Zinc; Chloride of Antimony; and Arsenic. The ordinary caustic measures are the galvano-cautery; Paquelin's cautery; the red-hot iron; and moxæ. *See also* POISONS.

USES.—Caustics are chiefly employed to destroy unhealthy, exuberant, or malignant growths; to establish issues for the purpose of counter-irritation (*see* COUNTER-IRRITATION); and to destroy poisons when introduced into the body by breach of the external surface. T. LAUDER BRUNTON.

CAUTERETS, in the French Pyrenees.—Sulphur waters. *See* MINERAL WATERS.

CAVERNOUS.—A peculiar quality of sounds heard on auscultation of the lungs, indicative of the presence of a cavity. *See* PHYSICAL EXAMINATION.

CAVITY, Pulmonary.—As the result of certain morbid processes which terminate in the destruction of portions of the pulmonary tissues, abnormal spaces or excavations are frequently formed in the lungs, which are designated *cavities* or *vomicæ*. These are usually associated with, and are by far most important in that large class of cases which are grouped under the term Phthisis. They may, however, originate under other conditions, namely, as the result of abscess or gangrene of the lung; of the destruction of morbid growths or hydatid cysts; of dilatation of the bronchi; or of destruction of the pulmonary tissue from without, in connexion with glandular disease, empyema, and other lesions. The most recent observations on this subject are given in the article VOMICA.

Pulmonary cavities present wide variations in different cases as regards their number, size, shape, condition of their walls, amount and nature of their contents, and other particulars. Usually they begin to form in the upper part of one lung, but subsequently they are produced in other parts, frequently both lungs becoming more or less involved, and any portion may be excavated in the first instance. A cavity frequently goes through certain stages, namely, those of formation and extension; of arrest; and of healing or contraction, which may terminate in ultimate closure and obliteration of the vomica. Enlargement of cavities is effected either by progressive implication of their walls, terminating in their disorganisation and removal; or by coalescence of adjacent spaces, the intervening lung-tissue becoming destroyed. During this process of destruction some of the tissues often escape more or less, especially the vessels, which may not uncommonly be seen traversing the spaces or running along their walls, their channel being obliterated. When an excavation is arrested in its progress, it becomes lined by a smooth membrane, and a more or less purulent fluid is secreted within it. This cessation of active mischief may not take place until a whole lobe, or even the greater part of the lung, is involved, a huge cavity being formed, which presents no tendency to contract. In other instances the progress of destruction is stayed, the formation of purulent matter is checked and finally ceases, a fibroid tissue forms, and the space undergoes a process of contraction or cicatrisation, which may end in a complete cure, but more commonly merely diminishes the size of the vomica more or less. At a post-mortem examination in cases of phthisis it is common to find numerous cavities in the various conditions and stages indicated above. Occasionally a vomica gives way into the pleura, followed by pneumothorax and its consequences.

Clinically, the existence of cavities in the lungs can only be ascertained positively by physical examination of the chest; and as a rule not only their presence, but their conditions, may by this means be determined with tolerable accuracy. The physical signs vary considerably in different cases, and are more conveniently described in other articles. *See* PHTHISIS; PHYSICAL EXAMINATION; and VOMICA. FREDERICK T. ROBERTS.

CELL (*cella*, a cell in a honeycomb; a closed chamber).—The term 'cell' was for a long time applied in anatomy to various spaces in the body large enough to be recognisable by the naked eye; hence 'cellular' tissue, a name which is still often used to designate areolar or connective tissue. But the word came afterwards to be applied by botanists in an entirely different sense, namely, to the hollow, bladder-like particles of which many of the parts of plants were shown by the microscope to be composed; and the name was extended so as to apply to similar particles in the animal body. It has since been retained and used in histology in that sense, although it has long been recognised that these particles, whether in plants or animals, but especially in the latter, do not necessarily conform to the original definition of a cell, the principal factor in which was the presence of a definite cell-wall.

Cells may be either *free* or *fixed*. Instances of free cells are to be found in the white corpuscles or leucocytes which occur in blood, in lymph, and pus, and which constitute the bulk of lymphatic or lymphoid (adenoid) tissue. As instances of fixed cells may be mentioned the various kinds of epithelium cells; the fixed cells of the connective tissue, including cartilage and bone; the cells of nervous tissue; and those which constitute the several kinds of muscular fibres. To these may be added the cells of most tumours.

All the cells in the body can be shown to have been ultimately derived from the ovum or egg-cell, which, after impregnation by and union with a spermatozoon or sperm-cell, divides at first into two, these again into two, and so on by a binary process of subdivision until a small mass of cells is ultimately produced. As the cells continue to multiply, this mass presently becomes hollowed out by the accumulation of fluid in its interior, and is converted into a vesicle the wall of which is eventually found to show an arrangement of its component cells in three layers, which collectively form the *blastoderm*. The three layers are termed respectively, from without in, the *epiblast*, *mesoblast*, and *hypoblast*, and give origin in course of development to the different tissues and organs of the body. The epiblast produces the cuticle and nervous tissues, and the essential parts of the sense organs; the mesoblast the muscular and connective tissues, including the blood and blood-vessels; the hypoblast forms the epithelium of the alimentary canal, and of the glands which open into it, including the epithelium of the pulmonary air-passages.

Cells vary very much in size, but few are large enough to be visible to the naked eye. Every cell in the body possesses one or more nuclei, although in some cells, in consequence of chemical alterations, the nucleus may have disappeared completely. Such cells are, however, invariably dead, and undergo only passive changes; of the living cell the nucleus appears, at least in all the higher animals and plants, to be an essential part.

The main part of the cell, in which the nucleus is embedded, is known as the *cell-body* or *cell-substance*. In most cells it is chiefly formed by a soft albuminous material, named *protoplasm*. It is upon the presence of this material that the so-called 'vital' phenomena which are manifested by the cell obviously depend, such as the amœba-like movements or changes of shape which are exhibited by free cells such as the white blood-corpuscles; the production, storage, and eventual expulsion from the cell of materials which are to take part in the formation of the secretions, as in the fixed cells of glands; and the internal changes, molecular or molar, which result in the wave-like transmission of impulses or movements, as is seen in the manifestations of activity which occur in muscle, nerve, and in ciliated cells. Most of these changes are or may be produced or modified by the incidence of external stimuli; and the property by virtue of which the protoplasm responds to these or other (unknown) stimuli is termed its 'irritability' or 'excitability.'

When protoplasm is examined chemically in the dead state it is found to be mainly composed, besides water, of certain forms of globulin and albumin, which do not materially differ from those which occur in fluids, such as egg-albumen and blood-serum, which exhibit none of the phenomena of life. But there is reason to believe that the molecular constitution of the protoplasm is very different during life from that which is found after death, being in the former condition of an especially unstable character and undergoing changes with great readiness. It is indeed in the highest degree probable that chemical and physical changes are *continually* proceeding during life, and that the chemical changes are of two antagonistic kinds, the one kind tending to produce a building up of fresh protoplasmic substance from the proteid and other material supplied by the blood and lymph, and the other kind tending to produce a breaking down of such substance, and a formation of simpler products. To these two hypothetical antagonistic processes which proceed during life, the terms *anabolic* and *katabolic* have been applied, while to the whole of the chemical changes which go on, both in the individual cells and in the collective organism, the name *metabolism* is given.

The forms assumed by the cells are very various; thus they may be spherical, ovoidal, spindle-shaped, flattened or scale-like, columnar, stellate—in short, of any conceivable shape. Fixed cells retain the same shape for an indefinite time, or undergo only passive alterations; free cells are frequently observed to alter their shape continually by the spontaneous protrusion and retraction of processes of their protoplasm (*pseudopodia*). These spontaneous changes or amœboid movements may, under certain circumstances, produce an actual locomotion of the cell, as is noticed to occur in the process of *diapedesis*, or passage of the white blood-corpuscles through the walls of the capillaries and venules.

Cells may lie scattered and isolated in a tissue, or they may be united by their processes into a network, as in the connective tissues, or closely packed and joined edge to edge to form either a membranous stratum or a solid mass of cells, which may constitute the bulk of the tissue to which the cells belong, as in the epithelial tissues. Or the cells of a tissue may undergo special development and structural modification, associated with the assumption of special properties of conduction and contractility, as in the nervous and muscular tissues. In ciliated epithelium the protoplasm of the cell is prolonged at the free border into minute hair-like projections, which during life execute a spontaneous lashing movement (*vibratile cilia*).

In spite of the numerous researches which have been made of late into the structure of cells, very little is known regarding the structure of the protoplasm. Until a comparatively recent date it was described as entirely without structure; and in many cells, especially those of the free type, it is difficult to make out any definite appearance of structure, especially in the living condition. It is true that under the influence of certain hardening re-agents, such as alcohol and chromic acid, a reticular appearance is produced in protoplasm, but the same appearance can equally well be produced in solutions of albumin and mucin under similar circumstances, so that the reaction in question by no means proves that the apparent structure is preformed; and it is still the opinion of some histologists that protoplasm is essentially structureless. It is certain, however, that in many *fixed* cells a network may be observed even in the living condition, the nodes of the network causing a characteristic finely granular appearance in the protoplasm, and most cytologists accordingly describe the living substance of a cell as being composed of a spongework (*spongioplasm reticulum*), and interstitial matter or matrix occupying the meshes of the spongework (*hyaloplasm enchylema*). Whether the vital phenomena exhibited by protoplasm depend upon the spongioplasm or the hyaloplasm, or belong to both these parts of the living substance, is entirely unknown.

The protoplasm of a cell may contain other materials embedded in its substance, which may either have been formed by the protoplasm from materials obtained from the blood, or in the case of 'free cells' may have been taken bodily into the cell-protoplasm by aid of the amœboid movements of which these cells are capable (inception of particles). These materials may be in the form of granules of albuminous, fatty, or carbohydrate nature, or of globules of watery fluid containing substances in solution (vacuoles). Such non-protoplasmic ingredients of the cell-substance, when occurring within the cell as ordinary products of its nutrition, are collectively termed *deuteroplasm*. This term also includes such portions of protoplasm as may have become converted within or at the surface of the cell into non-living material, as when the external layer of protoplasm becomes transformed by physical and chemical alterations into a firmer and more resisting covering to the cell, which thus becomes invested with a *cell-wall*. Pathological changes in cells are usually due to chemical transformations of the protoplasm, which in this case are usually termed *degenerations*, such as the *fatty*, *mucous*, and *colloid*.

Every cell in the body possesses at least one nucleus, but some cells—*e.g.* the white blood-corpuscles—may have two or three nuclei; and others, such as the giant-cells which are met with in normal red marrow and in certain pathological formations, may contain a large number. The nucleus of a cell is usually spherical; it is situated near the centre of the cell, and appears to possess the function of presiding over the nutritive changes of the protoplasm, as well as that of initiating the division of the cell.

Most nuclei have a well-marked reticular structure, which is visible even in the living cell unaltered by reagents. The filaments of the network have the property of becoming darkly stained by hæmatoxylin and many other staining reagents; hence the substance of which they are composed has been termed *chromatin*, to distinguish it from the part of the nucleus which remains unstained, and which is termed in contradistinction *achromatin*. The filaments are aggregated at the surface of the nucleus into a closely reticulated membrane, which serves to limit the nucleus externally. The nodes of the network, as seen in optical sections of the nucleus, give the latter a coarsely granular appearance, especially because the substance of the filaments tends to become aggregated at the nodes. Besides these aggregations there are usually present in the nucleus one or two larger masses of chromatin, staining somewhat differently from the rest, and not always situated at a node of the nucleus network. To these larger masses the term *nucleoli* is applied. In some nuclei the usual network is replaced by a sort of convoluted skein of nuclear filaments, the latter being somewhat thicker than usual, and exhibiting, when sufficiently magnified, a peculiar transversely striated appearance. This condition is, however, usually only met with in nuclei which are about to undergo division.

The division of the nucleus was formerly believed to occur by a simple process of fission, preceded by the division of the nucleolus. It is doubtful, however, if this simple process of *direct* division occurs regularly in any cells. In nearly every case of cell-division, both in normal tissues and in pathological formations, the nucleus undergoes a complete series of changes, which are collectively known under the name *karyokinesis* or *karyomitosis*, and which result in the division first of the nucleus and ultimately of the cell (so-called *indirect* division). The changes which are thus undergone are as follows:—The whole of the chromatin, including the substance of the nucleoli and the membrane of the nucleus, first becomes collected into one or more filaments, which have a convoluted skein-like arrangement, the skein being at first closely wound, and its filament or filaments fine, but becoming gradually more open, and its filaments coarser. Next, it is found that the skein has become subdivided into a definite number of short filaments, which often assume a bent, V-shaped form, with the apices of the V's directed towards the centre of the nucleus (*aster phase*). The V's then undergo an alteration in relative position, becoming interlocked at the equator of the now elongated nucleus, and having their apices directed towards the two poles. Usually at this *equatorial phase* of karyokinesis the filaments undergo a process of longitudinal cleavage, so that there are now twice as many as before. The resulting finer V-shaped filaments then begin to pass into two groups, which gradually tend towards either pole of the nucleus, assuming as they pass thither a radiate arrangement, with the apices of the V's towards the centre of each group. This is the *dyaster phase*. Finally, in each of the two groups, the V-shaped filaments unite end to end to form a skein, which subsequently becomes converted into a network, and the formation of the daughter-nuclei may now be regarded as complete. Around each one the corresponding half of the protoplasm of the cell becomes aggregated, so that two daughter-cells have become formed by division of the parent-cell.

While these changes are going on in the chromatin of the nucleus, others are proceeding in the achromatin substance. Within this a spindle-shaped system of the finest possible fibrils makes its appearance, both the poles and the equator of the spindle corresponding with those of the nucleus. At each pole of the spindle is a spherical particle termed the *polar particle*, and from this particle other fine fibrils radiate into the adjacent protoplasm, so that a system of achromatic fibres penetrates not only through every part of the nucleus, but throughout the greater part of the protoplasm of the cell as well. The fibres of the nuclear spindle appear to serve as directing lines along which the above-described movements of the chromatic filaments towards the poles of the nucleus occur, and the equator of the spindle determines the plane of separation both of the nucleus and of the cell.[1] E. A. Schäfer.

CELLULITIS. — Definition. — Cellulitis is the term applied to inflammation of the cellular or loose connective tissue, chiefly the subcutaneous areolar tissue, but also that interposed between muscles and viscera, or surrounding various organs.

The areolar connective tissue is so universally distributed throughout the body, that it is necessarily concerned in most inflammations—no matter of what structure; and in it, in fact, the chief changes generally take place.

To consider completely the pathology of inflamed connective tissue would be more or less to review the whole series of the acute diseases. We must limit our consideration to cases in which the cellular tissue is the chief or only tissue involved, or where changes in other parts are secondary to those primarily affecting the cellular tissue.

Beneath the skin, over the whole surface of the body, lies a layer of this tissue, containing within its meshes more or less adipose matter. It will be convenient to consider the changes which occur in it when inflamed, as they are identical with those in cellular tissue elsewhere.

Inflammation of the subcutaneous cellular tissue may be either *diffuse* or *circumscribed*, which are varieties rather in degree than in kind. The former is nearly always acute in type; the latter often, but not invariably so. A *chronic* form of cellulitis causing thickenings is observed in various regions, or it may be a sequel to the acute disease. The acute form of the disease is clinically similar to phlegmonous erysipelas, and is characterised by a spreading inflammation without tendency to arrest.

1. Circumscribed Cellulitis.—Ætiology.—Any injury to a part, whether of the nature of a wound or contusion; an impacted foreign body; or a fragment of bone, may cause cellulitis. Septic absorption from any decomposing secretion in a wound, altered blood, or infiltrated urine is prone to produce marked inflammatory changes in the connective tissue in different parts of the body. The poison introduced in a dissection- or *post-mortem* wound often occasions an acute cellular inflammation. Frost-bite, burns, inflammation of viscera, arteries, veins, or periosteum may produce inflammation of the adjacent cellular tissue; thus, inflammation of the kidney may cause perinephritis; inflammation of the uterus may lead to pelvic cellulitis; or some mischief in the greater bowel or rectum may produce inflammation and abscess in the loose cellular tissue around them (*perityphlitis* or *ischio-rectal abscess*); the poison also of scarlatina causes cellulitis of the submucous areolar tissue of the throat; and *angina Ludovici* is the name given to the cellulitis of the floor of the mouth and neck which is often associated with symptoms of intense septicæmia. A *sympathetic bubo* is an irritated lymphatic gland causing inflammation of the cellular tissue around it.

Pathology.—Pathologically, areolar connective tissue is of the greatest importance in the organism, being the most frequent seat of inflammatory and other changes. It mainly consists of loosely interlaced bundles of fibrous tissue, with flattened connective-tissue corpuscles adherent to them, and leucocytes, or amœboid corpuscles, in the areolæ. The exact part played in inflammation by the cellular elements is not quite settled. Under ordinary circumstances the leucocytes doubtless proliferate, and the fixed corpuscles probably do so also. Even under the influence of a slight irritation the flattened corpuscles in a few hours become globular, and present many nuclei in their interior—changes certainly pointing towards proliferation; while the very rapid increase of cells which takes place points to their derivation from cells pre-existing in the part, although the immigration of leucocytes from the blood into the inflamed part adds considerably to their numbers. Whether the perversion of nutrition which forms the starting point of the disease first induces a local cell-proliferation, or an immigration of leucocytes, or what proportion these two processes bear to each other, is difficult to determine.

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[1] It is difficult to make these changes in the cell and cell-nucleus perfectly clear without the aid of illustrations. The reader who desires a more complete account of the subject is referred to *Quain's Anatomy*, 10th edition, vol. i., where also a list of recent articles dealing with the question will be found.

The disease consists essentially in a very active cell-proliferation and increase. Whether the cellulitis be circumscribed or diffuse, similar changes occur; the difference between the varieties being that in the former there is formed a limiting zone of vascular tissue resembling granulation-material, which is absent when the inflammation is diffuse. There are otherwise no anatomical differences. When cellular tissue inflames, the part swells from the sero-fibrinous exudation poured out from the distended capillaries; its meshes are filled with young round cells, partly by proliferation of the connective-tissue corpuscles, in part by the accumulation of migrating leucocytes; and the circulation is interfered with by the pressure of the effusion, complete stasis sometimes taking place. While the cell-increase is proceeding, the fibrillar intercellular substance gradually disappears, in part by necrosis, and in part by becoming liquefied; and the tissue is finally transformed into pus. When this has happened the deeper layers of the skin disintegrate; it becomes undermined and gradually thinner; necrosis in one or more places follows; and the pus mingled with shreds of dead cellular tissue escapes, the latter resembling nothing so much as soaked washleather. The pus, at first thin and serous, subsequently becomes laudable. There is always a great tendency to suppuration, the vitality of areolar tissue being very low; but resolution sometimes takes place without formation of pus. The consequences of cicatrisation differ, according to the tissue or organ involved and the extent of the disease; but essentially they are similar everywhere. A gradual contraction sets in. In external parts we can observe atrophic changes taking place, followed sometimes by deformity or loss of function, while in the viscera the condition is known as cirrhosis. The special tissue of an organ or of a muscle cannot be reproduced; it is replaced after an injury by connective-tissue cicatrix. In such tissues as bone, tendon, and nerve, however, the cicatrix will usually be converted into the normal tissue of the part.

Symptoms.—The amount of fever varies with the extent of the disease and the nature of the cause. When the cellulitis is quite limited there may be little or none, but deep-seated or extensive cellulitis produces considerable constitutional disturbance. Painful swelling of the inflamed part will first be observed; the skin soon becomes tense, red, and œdematous, although at the outset it is sometimes paler than normal. The redness is gradually lost towards the periphery of the swelling, and is darker, or of a bluish-red tint in the centre, from the obstruction to the exit of blood; the swelling is doughy, inelastic to the touch, and pits on pressure. The inflamed region feels hard, the induration ceasing by no well-defined border. If resolution occur all these symptoms subside. A greater or less amount of thickening of the tissue may, however, persist—often for a lengthened period, the parts slowly returning to their normal state. In the central portion suppuration is, however, the rule. When it occurs, the pain and tension diminish; fluctuation is felt—obscure at first; the pus by degrees approaches the surface, and escapes spontaneously, or by an artificial outlet which may be provided. When the inflammation is more deeply placed, especially when beneath strong fasciæ, there will at first be no well-marked redness or swelling of the skin, or only a slight pinkish hue, with some œdema, to indicate the changes taking place beneath; and fluctuation may be difficult or impossible to make out long after pus has formed; but the pain and fever are considerable. This variety of the disease may also terminate in resolution—especially when early and appropriate treatment has been adopted; or in suppuration. It may also become chronic; or relapses may take place after temporary amendment. If the cause of irritation be a slight one, but repeatedly renewed, permanent thickenings or atrophic changes in the tissue may result; or the circumscribed may be converted into diffuse cellulitis. A very intense irritant sometimes induces gangrene. The same event may happen if a previously diseased tissue be attacked, as an anasarcous limb; or pressure, associated with the cellulitis accompanying the formation of bed-sores, may be sufficient to cause it.

2. **Diffuse Cellulitis.**—Synon.: Diffuse phlegmon; Pseudo-erysipelas; Diphtheria of the cellular tissue.—This is a severe disease, attended by general symptoms of a marked character, frequently associated with septicæmia, of which it may be both a cause and an effect.

Ætiology.—The most frequent cause of diffuse cellulitis is some form of septic infection. In the extremities the disease may originate from some trifling cause, especially in those whose constitution is impaired by age, privation, or excess; in the hand and forearm of such persons it is especially common after wounds on the finger or an insignificant whitlow. In convalescence from acute febrile diseases, especially typhus or typhoid, a local phlegmon is sometimes transformed into a diffuse cellulitis.

Symptoms.—The local symptoms of diffuse cellulitis resemble those of the circumscribed form, but are more intense: the disease is not limited, and it is accompanied by severe constitutional disturbance.

A sudden rigor with elevation of temperature often ushers in the attack; the rigor may recur at intervals, but sweating is unusual, and vomiting infrequent. In the affected region the patient experiences a great sense of weight and distension, with severe dragging pain. When the inflammation is deep-seated the changes in the skin may not be well-marked, even after a considerable extent of the cellular tissue has perished. This peculiarity is a very dangerous one, because it leads to the nature of the affection being for a time overlooked and efficient aid postponed. When the skin participates, the redness is duskier in hue, less sharply defined, and less easily dispersed by the pressure of the finger than in the cutaneous inflammation of erysipelas, while it soon becomes œdematous. The affected area feels brawny, hard, and swollen throughout, and is extremely tender and painful; sleep is interfered with; any movement causes great suffering; the fever is often very high; the secretions are diminished; and the appetite is lost. Rigor and sweating presently announce the formation of matter. The swelling becomes less prominent and more soft; the skin is mottled, thinned, and yielding in places; and the fever and pain subside. Convalescence may take place on the evacuation of the pus; or the rigor may be renewed, the fever reappear or continue, and the patient sink with symptoms of blood-poisoning. The more deeply the inflammation extends the more tedious is recovery, and the more liable is the patient to relapse. The muscles, tendons, and adjacent joints may become involved in the suppuration; or perforation of a dangerous character of neighbouring cavities or organs may take place. Suppuration consequent upon diffuse cellular inflammation will sometimes extend up the forearm to the elbow, undermine the skin, dissect the muscles, open into the finger- and wrist-joints, cause necrosis of tendons, and terminate in the loss of the limb by amputation, or perhaps in loss of life from septic poisoning. Should recovery ensue, the limb is often permanently crippled from the matting together of muscles and tendons, the impaired mobility of the joints, and the adhesions that take place between tissues which should freely glide over one another. Suppuration is the rule, but under favourable circumstances, and with early and suitable treatment, it may occasionally be prevented. Usually pus has already formed when the case comes under observation, and the surgeon has only to use his bistoury to evacuate the matter and thus limit the spread of the disease.

The irregular cavities and sinuses left after the evacuation of the dead tissue often suppurate for a long time, and this may lead to amyloid degeneration of the viscera. The thromboses which form of necessity in the smaller veins implicated in the inflamed area may break down and lead to septic embolism and pyæmia. The risk of this complication is a serious and ever-present one in these cases.

Diagnosis.—Cellulitis has chiefly to be diagnosed from erysipelas. Erysipelas may involve the subcutaneous tissues, and cause inflammation and suppuration of the connective tissue, but it always begins in the skin, which is more extensively affected. Inflammation of the cellular tissue begins beneath the skin, where the swelling and effusion first take place; the skin becomes involved later, and usually to a less extent, while it may remain, at least for some time, almost entirely free; the redness, too, is less bright, and more diffused, not presenting the distinct margins of erysipelas, but fading into the surrounding parts. In the later stages the two conditions are scarcely distinguishable.

At first it may be difficult to decide whether the case is one of inflammation of the subcutaneous cellular tissue, of the intermuscular areolar tissue, or of that connected with the periosteum, or around a vein. The greater the general swelling of the limb, the more considerable the fever and the pain, and the less the redness of the skin, the more probable is it that the inflammation affects the more deeply seated structures.

Prognosis.—The prognosis of cellulitis depends on the extent and severity of the disease and the constitution of the patient.

Treatment.—The local cause should be removed, as far as practicable. If the wound be in a foul condition it should be rendered aseptic. Absolute rest to the inflamed parts is of great importance. So long as suppuration has not occurred, resolution is possible. Graduated pressure can rarely be tolerated. Blistering is not employed in the acute form, but may be useful in removing more chronic changes. Cold applications and ice may abate pain and inflammation, but in many cases warm fomentations and poultices give relief. In the more advanced stages, especially when they tend to become chronic, cold is useless or even dangerous, from liability to cause gangrene in debilitated subjects. Local blood-letting does not prevent suppuration, and is usually contra-indicated by the weak state of the patient. When pus forms, or its presence is suspected, a sufficiently free outlet should be provided for it as soon as possible. Nothing so effectually checks the further spread of the disease. The incision should be made at the most prominent point. It is often better to make a number of small incisions, from half an inch to an inch in length, than one long one, which is apt to be followed by serious bleeding, and does not so efficiently relieve the strangulated tissues. When suppuration is only suspected, incisions should nevertheless be practised without delay, without waiting for fluctuation. Pus and shreds of dead cellular tissue should be frequently washed out of the wound with an irrigator. No force should be used to remove portions of dead tissue; any dragging tends to rupture the small blood-vessels, and to destroy the remaining connexions of the skin with the deeper structures. Antiseptic precautions must be zealously carried out.

When a joint is involved, or when the patient is exhausted by the discharge, and the tissues are spoiled, amputation is often necessary. Excision may be practised if the condition of the soft parts admits of it. But these are points for the surgeon's consideration.

The general treatment consists in giving nourishing food and stimulants, combined with opiates to relieve pain, and iron, quinine, and other tonics.

William Mac Cormac.

CEPHALALGIA (κεφαλή, the head; and ἄλγος, pain).—Pain in the head. *See* Headache.

CEPHALHÆMATOMA (κεφαλή, the head; αἷμα, blood; and *oma*, a formative suffix indicating a tumour).

Definition.—An effusion of blood occurring in newly born infants, forming a tumour upon the head; situated beneath the pericranium, upon the surface of the skull; or more rarely beneath the skull, between it and the dura mater.

Description.—This disease is of very rare occurrence, and must not be confounded with the *caput succedaneum*, which is an effusion of serum external to the pericranium, and of common occurrence. The blood is generally extravasated immediately beneath the pericranium, over one of the parietal bones, most frequently the right, but it may occur over the frontal or occipital. Combined with this, or arising independently, but of extreme rarity, may be an effusion beneath the cranium. The origin of cephalhæmatoma has been attributed to a variety of causes, but is most probably due to the constriction of the margin of the os uteri during labour. It is generally observed some hours or a day after birth, as a circumscribed swelling, slightly tense and fluctuating; and its peculiarity consists in a bony circle surrounding and limiting it.

Diagnosis.—These tumours have been mistaken for hernia cerebri; but their situation over the bone away from the fontanelles, the absence of pulsation, and the existence of fluctuation in cephalhæmatoma should prevent this mistake.

Prognosis.—Generally the blood becomes absorbed, but occasionally suppuration occurs, or the bone may become necrosed; if beneath the skull, serious consequences, including idiocy, may ensue.

Treatment.—As a rule, cephalhæmatoma is not to be interfered with. If suppuration take place the pus must be evacuated.

Clement Godson.

CEREBELLUM, Lesions of.—The cerebellum is liable to the same diseases as the brain and nerve-centres generally, such as hæmorrhage, abscess, various forms of degeneration, tumours, &c. The nature of the pathological condition is to be determined by the symptoms peculiar to each, so far as this is possible. Its locality in the cerebellum is to be diagnosticated, first, by certain symptoms which are due to the cerebellar lesion as such, which may be termed the *direct* symptoms; and, secondly, by those symptoms which depend more on the influence exerted by the lesion on neighbouring or subjacent centres and structures. These latter may be termed the *indirect* symptoms.

It is by no means easy to separate these symptoms from each other, and to say how much is due to interference with the functions of the cerebellum, and how much to interference with the functions of other parts. There are few diseases which have a purely local organic or functional limitation. Hence, in order to arrive at the symptoms peculiar to cerebellar lesions, it is necessary to exclude all pathological affections which in their very nature affect the whole of the intracranial centres, such as tumours or meningitis. The most satisfactory conclusions, from a pathological point of view, are to be drawn from cases of atrophy or degeneration of the cerebellum, and, from a physiological point of view, from the results of the experimental lesions of this organ in the lower animals.

The evidence from these two sources is mutually supporting.

Direct Symptoms.—The characteristic symptoms of cerebellar disease are disorders of equilibrium, shown, on attempts at locomotion, in a reeling or staggering gait (titubation), and a continual tendency to stumble or fall over the most trifling obstacle, or on hurried movements.

These symptoms may be confounded with locomotor ataxy, but careful observation will show that in cerebellar disease there is no true ataxy. The movements are quite coordinated with each other, and are such as would instinctively be made to prevent falling, or to preserve the equilibrium; and have none of the precipitate, irregular, and sprawling character seen in ataxy. They are not specially intensified on closure of the eyes, which is such a marked feature in ataxy. Nor are they accompanied by any of the sensory affections of ataxy, whether in the form of pains or anæsthesia.

There is no true motor paralysis in cerebellar disease as such, and the various volitional movements of the limbs can be carried out perfectly well in the recumbent posture. Sensation, general and special, is not directly affected in cerebellar disease. Nystagmus and strabismus have been observed, more particularly in connexion with lesion of the cerebellar peduncles. Defects of articulation have been noticed, but it is very doubtful whether they should be regarded as direct symptoms.

Lesions of the cerebellum may be entirely latent, or not cause any very obvious symptoms during life. This has been observed in cases of congenital atrophy, or when the disease has been of a slowly progressive character, or limited to one lobe. Affections of the middle lobe are specially calculated to induce the characteristic symptoms.

INDIRECT SYMPTOMS.—*Pain in the head*, more particularly at the back, though not constantly situated there, is frequently associated with organic disease of the cerebellum.

Vomiting is also very frequently observed, perhaps more constantly than in connexion with diseases of other parts of the brain. There is, however, no reason to regard this as due to cerebellar disease as such. It is probably due to indirect effects on the medulla. As a general rule, diseases tending to encroach on the space of the posterior fossa, or to increase the pressure in this region, have a similar effect.

Hemiplegia is not uncommon in connexion with cerebellar disease, and more particularly in cases of tumour or hæmorrhage in the lateral lobe of the cerebellum. The hemiplegia is on the side opposite the lesion. This does not prove that the hemiplegia is due to the destruction of the cerebellar lobe, or that the cerebellar lobes have cross relations with the limbs. Experimental physiology and anatomical investigations tend to show that the cerebellar lobes are functionally related to the motor tracts on the same side. This is also borne out by the fact that atrophy of the lateral lobe of the cerebellum follows disease and degeneration of the opposite cerebral hemisphere. The hemiplegia from cerebellar disease is, therefore, in all probability, due to compression or some affection of the subjacent motor tracts, which decussate at the pyramids. The fact that it occurs chiefly when the disease is limited to the lateral lobe is what might be expected on anatomical grounds.

Affections of sensation, common and special, have been observed in cases of cerebellar disease. Diminution of tactile sensation on the opposite side of the body, when the disease is situated in the lateral lobe, is to be accounted for in the same way as the motor paralysis. As regards the special senses, affections of sight have been most frequently noted. Sight is certainly not abolished by destruction of the cerebellum in the lower animals, and when blindness occurs in man in connexion with diseases of this organ, it is due either to implication of the corpora quadrigemina, functionally or organically, or to secondary degeneration in the optic tracts, as the result of neuritis.

A special feature of *tumours* of the cerebellum, more especially of the middle lobe, is a tonic rigidity of the muscles of the back of the neck, with retraction of the head, associated frequently with flexion of the forearms, and extension of the lower extremities and pointing of the toes. In these cases also, psychical affections, more particularly mental hebetude or stupor, occur as the result of secondary dropsy of the ventricles, caused by pressure on the veins of Galen. The symptoms then become those of hydrocephalus.

Hæmorrhage into the middle lobe of the cerebellum, in addition to the ordinary symptoms of apoplexy, has been frequently found to cause vascular excitement of the genital organs—in the male marked *priapism*. This symptom, of which several cases were first reported by Serres, led this observer to modify the view of Gall that the cerebellum, as a whole, was related to the sexual instinct, and to regard the middle lobe only as having any such function. The facts, however, are susceptible of a totally different interpretation, and one more in harmony with other data of physiology and pathology. It has been found experimentally by Segalas and by Eckhard that irritation of the posterior surface of the medulla and pons gives rise to vascular excitement of the generative organs, and hence the symptoms in cases of hæmorrhage into the middle lobe are to be ascribed to irritation of this region. This also explains the absence of the symptoms when the hæmorrhage occurs into the lateral lobes. There is absolutely no evidence of the slightest value in support of Gall's hypothesis. The facts of clinical medicine go a considerable way in diametrical opposition to it, if they are not themselves sufficient entirely to overthrow it.

Cerebellar Peduncles.—Respecting the effects of disease of the restiform tracts or inferior cerebellar peduncles we have no definite knowledge.

Cases, however, are on record in which lesions have been found involving principally either the superior or middle cerebellar peduncles. The symptoms, in the main, agree with those observed by Magendie on section of the middle peduncle in the lower animals. The chief effect of this lesion was to cause an irresistible tendency to roll over towards the side of lesion. Together with this rotatory disturbance of the equilibrium, a peculiar distortion of the optic axes was observed, the eye on the side of lesion being directed downwards and inwards, the other looking upwards and outwards.

In a case described by Curschmann (*Deutsches Archiv f. klin. Med.* xii. 356), along with appearances of basilar meningitis, which somewhat complicated the case, there was found a focus of softening, surrounded by capillary hæmorrhage, in the right superior cerebellar peduncle. The symptoms observed in this case were a rotatory distortion to the right side, to which position the patient invariably returned when resistance to this movement was withdrawn. There was no motor paralysis, nor was there any distortion of the optic axes.

A case has been put on record by Nonat (*Comptes Rendus*, 181) of apoplectic extravasation into the right middle peduncle of the cerebellum and right cerebellar hemisphere. In this case the head and trunk were twisted towards the right side, and the ocular symptoms were also present, the eyes being immovable in a position of skew deviation. Other cases are on record in which the cerebellar peduncles have been involved in more extensive lesions; but the symptoms, though not opposed to those above related, are incapable of differential analysis. The special diagnostic symptoms, therefore, of lesion of the cerebellar peduncles are what are frequently termed 'forced movements' (*Zwangsbewegungen*), or distortions of the normal axis of the trunk. The exact direction of the distortion, in consequence of lesion specially limited to one or other peduncle on the right or left side respectively, is somewhat doubtful, though as a rule it has been found towards the side of lesion. Much, however, will depend on whether the lesion is of an irritative or inflammatory, or of a destructive character. A lesion of an irritative nature, though occupying the same position as a destructive lesion, would exactly reverse the direction of the distortion of the head and trunk. D. Ferrier.

CEREBRAL ABSCESS.—*See* Brain, Abscess of.

CEREBRAL APOPLEXY. — *See* Apoplexy, Cerebral.

CEREBRAL ARTERIES, Diseases of.—*See* Brain, Vessels of, Diseases of.

CEREBRAL HÆMORRHAGE.—*See* Brain, Hæmorrhage into.

CEREBRITIS.—Inflammation of the brain-substance. *See* Brain, Inflammation of.

CEREBRO-SPINAL FEVER. — Synon.: Epidemic Cerebro-spinal Meningitis; the Black Sickness (popular, Dublin); Fr. *Méningite cérébro-spinale épidémique*; Ger. *Cerebral-Typhus*; *Epidemische Meningitis*.

Definition.—An acute epidemic febrile disease, characterised by sudden invasion, with extreme nervous shock, vomiting, excessive pain referred to the back of the neck and spine, spasmodic contraction of muscles, excessive sensibility of the skin, and frequently delirium; accompanied by purpuric eruptions, either circumscribed, raised, hard, and shotty to the feel, or extensive purpuric spots or patches, frequently accompanied by vesicular eruptions, usually of herpetic but sometimes of a pemphigoid character; and often purulent inflammation of the eyes. *Post mortem* there are found: inflammation of the membranes of the brain and spinal cord, especially of the arachnoid, with deposit of white, yellow, or greenish-yellow lymph upon the surface of the arachnoid, especially at the base of the brain and anterior portion of the medulla oblongata and spinal cord, and effusion of serum into the ventricles and sub-arachnoid spaces.

Ætiology.—*Age.*—Cerebro-spinal fever is more commonly met with among children under ten years of age; after childhood it usually attacks those approaching the age of puberty or in early adult life; it is seldom met with after the age of thirty-five years, and is very rare after forty.

Sex.—The disease is much more frequent in adult males than females—robust males between the ages of fifteen and thirty are its chief victims; but among children it seems to attack both sexes almost equally.

Occupation.—It seems specially to affect young recruits in the army, as was the case in the French epidemics. In Dublin it was specially severe among the recruits of the Royal Irish Constabulary stationed in the police barracks in the Phœnix Park. There does not appear to be any other occupation which predisposes to cerebro-spinal fever. Excessive fatigue seems to increase the liability to the disease: it has arisen after a hard day's hunting, foot-racing, long walks, dancing, or in children exhausted from outdoor play.

In epidemics it occurs in isolated localities far apart from one another: it does not seem to extend from a district to adjacent districts; thus resembling affections connected with marsh miasms, and evidently requiring some very special local conditions to secure its spread. Micro-organisms similar to those described in pneumonia have been found in connexion with this disease, but no microbe has been discovered which can as yet be specifically associated with it.

Season and Climate.—Cerebro-spinal fever is widely distributed in the temperate zone. It prevails more in cold than in hot weather;

in Ireland it has usually prevailed in winter and early spring.

General Sanitary Conditions.—It seems to be less influenced than most other epidemic affections by general sanitary conditions.

Communicability.—It is generally believed not to be contagious. A few doubtful cases of contagion have been recorded; except, however, where it has appeared as an epidemic among recruits, there are comparatively few instances of more than one case arising in any particular house or circumscribed locality.

Epidemic Influence.—The disease is undoubtedly epidemic in its character.

Unwholesome Food.—It has been suggested that cerebro-spinal fever owes its origin to the use of breadstuffs made from diseased grain, but there is no proof of such being the case.

Anatomical Characters.—Cadaveric rigidity is well-marked. Large purpuric patches form after death, even in cases where there were no purpuric symptoms during life; in some cases the whole body has turned black. On incision a large quantity of dark, tarry-looking blood exudes; the muscles are darker than usual, and in prolonged cases much weakened and wasted. There is increased vascularity of the scalp; the cerebral sinuses are much distended with dark blood; and serum is found in the sub-arachnoid spaces and ventricles. All the membranes of the brain may be more or less congested, the arachnoid being always extremely vascular and opaque from deposits of lymph—this opacity varies from slight milkiness to thick and dense deposits. The most marked intracranial lesion is the white-yellowish or yellowish-green 'fibrinopurulent' deposit found at the base of the brain. This deposit varies somewhat with the duration of the disease: in cases which die early the deposit is usually slight, whitish, and soft; in those which live for a week or so it is yellowish or greenish; in prolonged cases the deposit is more white and pure, the effused serum greater in quantity, and the vascular fulness less. The origins of the nerves seem to be buried in and compressed by the deposit. The brain-substance itself is more vascular than normal, but not otherwise altered. In the spinal cord the lesions are similar to those found in the brain and its membranes. In some cases purulent infiltration of the eyeball, and effusion into the joints have been met with. The lungs, liver, and spleen have been found much congested and softened in many cases.

Symptoms.—The patient is usually attacked suddenly, when apparently in vigorous health, by faintness, vomiting of greenish matter, and intense pain referred especially to the back of the head and neck; the extremities become cold; the patient becomes insensible and sometimes convulsed; the limbs become rigid. On recovering from the collapse, the patient complains of great pains in the head, back of neck, and along the spine; the head is drawn back, so as to be almost at a right angle with the spine; the whole back is sometimes arched, as in tetanus; the muscles become rigid, and the skin excessively sensitive; neuralgic pains are also complained of in all parts of the body. In most of the severe cases eruptions appear within the first twenty-four hours. The eruption usually appears first on the legs, and is frequently confined to the lower extremities. The spots are usually black, raised, about a line in breadth, and feel like a grain of shot under the skin. Sometimes these raised spots are surrounded by a dark purplish areola; in most cases large purpuric patches of many inches in extent form on various parts; sometimes they coalesce and cover the entire body. Vesicular eruptions are also common; these usually have the character of herpes, and are most frequent on the face, neck, and shoulders. The herpetic eruptions are met with as frequently in mild as in severe cases. Pemphigus sometimes appears in the advanced stages of the disease. When reaction sets in, the temperature is found to have risen to from 100° to 103° or 104° F., and in some cases has reached 107° F. In many cases the temperature never rises, and the patient dies in the stage of collapse; the respiration becomes of a sighing character; the pulse rises to about 120, and has a peculiar jerking character, giving a sharp upstroke to a sphygmographic tracing.

The foregoing symptoms are very variable; any one, or even a considerable number of them, may be absent throughout the whole course of the case.

Complications and Sequelæ.—Complications connected with the nervous system are the most often seen. Paralysis of one or more limbs is common, of a hemiplegic character, and most frequently attacking the arm. Deafness is not very common, but has been met with in several cases, sometimes becoming permanent. The eye-complications are among the most frequent and most serious. The eye may be attacked with a low form of inflammation, terminating in purulent infiltration of the whole or part of the organ; the cornea is more frequently involved than any other portion; and this sometimes giving way, the whole contents of the globe escape, causing hopeless loss of the eye. The sight is also often permanently impaired by iritis, or opacity of the cornea. In many cases, however, the inflammation completely subsides. It is remarkable that it is the right eye which is usually attacked, that both eyes are seldom affected, and rarely the left eye alone. Acute inflammation of the larger joints is a frequent complication in some epidemics; this often terminates in purulent intra-articular effusion. Hæmorrhages are frequent in the more malignant forms, and are almost always present in cases where the purpuric blotches are of large extent; these hæmorrhages have occurred from the nose, uterus, bowels, kidneys, and ears in about the foregoing order of frequency. Gangrene is occasionally met with, and the cases in which it occurs are usually fatal; although toes have been lost, and yet the patient has recovered. The purpuric patches have also sloughed without serious danger to the patient's life.

Diagnosis.—Cerebro-spinal fever is liable to be confounded with typhus fever, on account of the petechial rash, but is distinguished from it by the eruption appearing suddenly, without any previous mottling of the skin. The nervous symptoms also distinguish it from typhus, although in a case of typhus complicated with cerebro-spinal meningitis the diagnosis is extremely difficult, and may be impossible. It is distinguished from *purpura hæmorrhagica* by the intensity of the fever, and the localised nervous symptoms. The malignant cases are more likely to be mistaken for malignant scarlatina than for any other disease, and must be distinguished therefrom by the rash, sore-throat, and nervous affections; yet in some cases the two diseases have been indistinguishable from each other, especially where death occurred within twenty-four hours and both were epidemic at the time. In other cases malignant small-pox has been mistaken for this disease.

Prognosis, Duration, Terminations, and Mortality.—The prognosis, duration, &c., of cerebro-spinal fever depend much upon the form the affection assumes, and for convenience we may divide it into the following forms:—

1st. Cases of a very mild form, terminating in recovery; the duration being usually from one to three weeks.

2nd. Cases of a very severe form, setting in suddenly; the symptoms being very violent and well-marked, accompanied by purpuric spots and blotches, with a tendency to hæmorrhages, with deep collapse and coma; usually terminating fatally in from a few hours to three days.

3rd. Cases of medium severity, where all the nervous symptoms set in with less suddenness than in the second class of cases, purpuric blotches not being usually present, and no hæmorrhages. These usually yield to treatment, and terminate in recovery in from two to six weeks.

4th. Cases which set in either in a mild or in a severe form, but in which, on the subsidence of the fever, the strength does not return, convalescence is retarded or arrested altogether, and the patient falls into a general atrophic condition, and usually dies, in from three to six months, of marasmus.

By deciding to which of the above classes the case belongs, the prognosis will be to a great extent determined. The chief indication of danger is the early appearance of purpuric and hæmorrhagic conditions. Patients who have for from ten days to a fortnight escaped serious complications usually recover.

The mortality in cerebro-spinal fever is very high—probably on an average about 60 per cent. In some of the American epidemics it is placed as high as 75 per cent. Among the Irish constabulary it reached 80 per cent. Like other epidemic diseases, the mortality is highest at the commencement of the epidemic. It is most fatal about the age of twenty, and less so under fifteen years.

Treatment.—The treatment in the early stage must be directed to recovering the patient from the collapse. This is best done by the application of heat, the administration of small quantities of stimulants or stimulating enemata, and the application of sinapisms over the chest and back. In the next stage of the disease attention must be almost altogether directed to allaying the spinal irritation, and promoting the absorption of the effused matters. The extreme irritation will be best diminished by the use of belladonna and bromide of potassium. Ergot has also been found useful for this purpose. The pain, which is extreme, will yield best to frequent and considerable doses of opium; indeed, many physicians have relied altogether on opium as the curative agent. Chloral hydrate has proved beneficial, in conjunction with bromides, in allaying restlessness and procuring sleep. With a view of promoting absorption of the effused matters, mercury and iodide of potassium have been chiefly relied upon. In the more sthenic cases calomel may be employed with benefit in small and repeated doses. The disease being usually of an asthenic type, mercury will seldom be well borne, and iodide of potassium should be preferred. Leeches applied to the back of the neck, behind the ears, or to the temples, produce great relief of the excessive pain in the head and upper part of the spine. The application of ice to the head and spine temporarily allays pain, but there is little evidence of permanent benefit being derived therefrom. In prolonged cases blisters applied along the spine have been favourably spoken of. The local complications must be treated as they arise, and according to general principles applicable in each case. Stimulants are required in considerable quantity in a very large number of the cases which present adynamic symptoms.

T. W. Grimshaw.

CEREBRUM, Diseases of. — *See* Brain, Diseases of; also Convolutions of the Brain, Diseases of; Corpus Striatum, Diseases of; &c.

CERES, in Cape Colony. — *See* Africa, South.

CHALAZION (χάλαζα, hail).—A small encysted tumour of the eyelids, colourless and transparent, somewhat resembling a hailstone.

CHALK-STONES.—This name is applied to the deposits which are formed in connexion with the gouty diathesis, especially in the joints. They are thus denominated from their appearance and physical characters, in which they more or less resemble chalk; but in their chemical composition they are entirely different, consisting mainly of urate of sodium. *See* GOUT.

CHALYBEATE WATERS (*chalybs*, steel).—Mineral waters which contain iron. *See* MINERAL WATERS.

CHANCRE (Fr. *chancre*). — Hard chancre is the initial manifestation of syphilis. *See* SYPHILIS. For Soft chancre, *see* VENEREAL DISEASE.

CHANGE OF LIFE.—SYNON.: Climacteric epoch; Sexual involution; Fr. *Ménopause*; Ger. *Menstruationsende*.

DEFINITION.—The time of life in a woman when the functions of the uterus and ovaries cease, menstruation terminating—a period when disease of these organs is especially prone to occur, and when various constitutional disturbances are almost certain to arise.

ANATOMICAL CHARACTERS.—Great changes occur in the sexual organs—the ovaries lose their smooth outline, and after a while become shrivelled up, occasionally only a trace of them remaining; the Fallopian tubes diminish in size, and sometimes become obliterated; the walls of the uterus atrophy, its cavity becomes much smaller, and the cervix disappears altogether.

SYMPTOMS.—The term 'change of life' is used among women very widely to signify everything which affects them at this critical time. It is so rare for the transition from activity to inactivity to take place without some disturbance locally, or constitutionally, that women are apt to neglect seeking advice for symptoms which should demand careful treatment, believing as they do that it is natural to suffer in such ways at 'the change.' There is no fixed period for the climacteric epoch, though roughly it may be said to occur between the ages of forty-five and fifty. Certain causes are apt to determine the time—amongst these are parturition and lactation, febrile attacks, such as typhus or acute rheumatism, profuse hæmorrhages, fright, &c.

The symptoms vary much. In some women the change is abrupt, menstruation ceasing all at once after perfect regularity; in others, and more frequently, the change is prolonged, the catamenia being irregular for many months, and varying as to periodicity and quantity. Frequently, after a long interval, a profuse flow with clots occurs, and this is very often attributed to a miscarriage. This loss is frequently beneficial, and if it do not take place, and if relief be not derived from vicarious discharges, such as bleeding from piles, the excess of blood gives rise to headaches, flushes, vertigo, and a host of other unpleasant symptoms. The balance between the nervous and circulatory system is upset; irritability of temper, hyper-sensitiveness and all sorts of fancies arise, or depression sometimes amounting to melancholia ensues. If germs of disease exist, the uterus is especially prone at such times to develop them, so that carcinoma, fibroid disease, and polypus frequently present their first symptoms at this epoch. The importance, therefore, of an early examination cannot be too forcibly dwelt on, or the mischief of delay from considering the abnormal condition as typical of 'the change of life,' and as a natural consequence, which will right itself. At these times pruritus of the vulva, vascular growths at the orifice of the urethra, and cutaneous eruptions are especially likely to occur. There is a tendency to grow fat, and to become coarse; hairs frequently appear on the face. The breasts often become very large and pendulous, and this, with the increase in the size of the abdomen from flatus, and the deposition of fat in its walls, together with the cessation of menstruation, not infrequently gives rise to the supposition of pregnancy. To this imaginary state the term *pseudocyesis* has been applied, and it is often almost impossible to set aside the opinion of the woman regarding her supposed condition. The headaches, neuralgia, loss of memory and nervous symptoms appear to be due to disturbance in the ganglionic system of nerves, with which the uterus and ovaries are largely supplied. If insanity arise, the most common form it assumes is hypochondriasis or melancholia.

TREATMENT.—This must be directed to regulating the secretions. Generally constipation, previously troublesome, becomes aggravated; and portal congestion frequently occurs. Saline purgatives are especially beneficial, and these may be administered in the form of mineral waters, such as Rubinat, Hunyadi János, or Friedrichshall. Blue pill with aloes is often very useful. The headaches and reflex nervous symptoms may be best combated by the administration of bromide of potassium, and this drug appears to act as a direct sedative to the sexual organs, besides diminishing the amount of blood determined to them. Occasionally, bleeding from the arm or cupping gives great relief. Attention must above all be paid to the diet. It should be plain and unstimulating: beer and spirits should be prohibited, and only light wines, if any, allowed. Tepid baths are useful. Late hours, heated rooms, and excitement of all kinds should be avoided. If local troubles arise, they must be treated according to their indications; as a rule, abstracting blood from the uterus does harm, but leeches to the anus are sometimes beneficial. It is clearly impossible to map out any empirical line of treatment for a condition in which the symptoms are so variable. Clement Godson.

CHAPPED NIPPLES.—*See* Breast, Diseases of; and Nipple, Diseases of.

CHAPS.—Synon.: *Rhagades.*—Cracks or fissures of the skin occur where the integument has become hardened by infiltration, as in the erythema of the hands and wrists in cold weather, in chronic eczema, psoriasis and lepra vulgaris. The *treatment* for chaps consists in protection from the atmosphere; careful drying after the hands have been washed or wetted; and the use of zinc ointment and glycerine soap. Diluted glycerine, vaseline, and cold cream are also popular remedies. Erasmus Wilson.

CHELOID (χηλή, a claw).—Synon.: Cheloma; Fr. *Chéloïde* (Alibert); Ger. *Keloid.*

Definition.—A tumour of the skin resulting from overgrowth of connective tissue within the corium.

Ætiology.—Cheloma may be idiopathic or accidental; the former is, however, of very rare occurrence; and in both cases it is referable to a diathesis. When of accidental origin it is commonly associated with a cicatrix, and is then developed in the midst of the cicatrix-tissue. This form of the tumour has been denominated *cheloides spuria* or *traumatica*, and, as such, has been seen scattered numerously over the chest and shoulders as a sequel of acne.

The traumatic cheloid may follow a light as well as a severe injury of the skin, such as a boil, a blister, a leech-bite, or even the irritation of a stimulating liniment; it is sometimes met with in the scars of strumous abscesses or ulcers, but is most common in the cicatrices of burns or scalds.

Anatomical Characters.—At its first development cheloma occupies the fibrous portion of the corium. As it increases in bulk, it pushes the vascular layer outwards and stretches the corpus papillare, obliterating the capillary network more or less completely. In its aggregate form, when it presents itself as a flat plate, raised for a quarter of an inch above the level of the adjoining skin and sinking to a similar extent into the corium, it has the appearance of being tied down by strong cords or roots at either end, and frequently overlaps the healthy skin along its borders. In this state it is seen to be composed of strong fibrous bands enveloped by a smooth transparent pinkish layer, in which may be detected a scanty vascular plexus converging to venules which sink between the meshes of the fibrous structure. Around the circumference of some of these larger flattened tumours, such as are commonly met with on the sternum, and measuring several inches in diameter, there will generally be observed a few scattered knots. These are developed in the fibrous sheath of the arteries at a short distance from the mass, and, being thus linked to the central growth, are subsequently drawn into the focus of the tumour. And the development of the so-called 'roots' is explained by the propagation of the proliferating process by the coats and sheaths of the blood-vessels communicating with the central tumour. Fully-formed cheloid consists of dense white glistening fibrous tissue, the fibres of which are closely packed and arranged in more or less parallel bands. Occasionally bands of fibres are seen running obliquely, but they follow a definite course, and present quite a different appearance from the irregular meshwork of fibres seen in the scar tissue. The cheloid grows up in the cicatricial tissue and pushes the latter aside, so that it can be seen surrounded by scar tissue. Cheloid also invades the healthy corium in the neighbourhood, and in this respect differs altogether from hypertrophied scar.

Description.—Cheloid has received its name from its habit of throwing out spurs from its circumference, these spurs having been compared to crab's claws. It originates in a round, oval, or oblong tubercle or knot in the skin, and this may be followed by a second in its immediate neighbourhood, or sometimes by a cluster of three or four. When two of these knots are situated at a short distance apart they are apt to become connected by a cord of the same structure as themselves, and to give rise to what has been called a *cylindrical*, *club-shaped*, or *dumb-bell* cheloid. When three or four knots are grouped near together they are disposed to become blended by growth, and produce an oval or square-shaped cheloid; and when the growth extends from these latter into the surrounding integument the appearance denominated *radiciformis* is established. Cheloma being due to a tendency to overgrowth or hyperplasia of connective tissue within the skin, it may appear on several parts of the integument at the same time, one of the most common seats of its development being the sternum, which it generally crosses transversely. It is often solitary; is more commonly composed of five or six tumours, discrete or confluent; but has been met with occasionally to the number of fifty or sixty tubercles or more.

Course and Prognosis.—Cheloid rarely gives rise to much inconvenience or attains any considerable magnitude. When left to itself, it progresses very slowly or remains stationary for a number of years or for life; and it has been known to disappear spontaneously. Its subjective symptoms are of no great severity, being limited to itching, tingling, and smarting, and more or less uneasiness in moving the limbs, or from pressure when sitting or lying in bed. It has no tendency to desquamation or ulceration.

TREATMENT.—Cheloid which forms in scar tissue should never be removed by the knife or caustics, as it almost always returns quickly after removal. It has a tendency to undergo slow atrophic changes if left to itself, and these changes are favoured by the pressure of a plaster. The mercurial plaster is a very suitable one.

ERASMUS WILSON. ROBERT LIVEING.

CHELTENHAM, in Gloucestershire.—Common salt waters. *See* MINERAL WATERS.

CHEMOSIS (χήμη, a hole).—A swollen condition of the conjunctiva, caused by effusion into its tissue around the cornea, which thus appears as if placed in a hole or hollow. *See* EYE AND ITS APPENDAGES, Diseases of.

CHEST, Diseases of the.—Following the plan adopted in the general article on the ABDOMEN, it is proposed in the first place to give an outline of the diseases of the chest; and then to indicate the principal points bearing on their clinical investigation.

GENERAL SUMMARY.—The diseases of the chest may be conveniently divided into certain groups, namely:—

I. Diseases of the walls of the chest, or extending inwards from the walls.

II. Diseases of the respiratory apparatus contained within the chest-walls, namely:—1. Pleuræ. 2. Trachea. 3. Main Bronchi. 4. Lungs.

III. Diseases connected with the circulatory system, including:—1. Pericardium. 2. Heart. 3. Great vessels within the chest, both arteries and veins.

IV. Diseases originating in the mediastinal cellular tissue.

V. Diseases of the absorbent vessels or glands within the chest; of the thoracic duct; and of the thymus gland or its remains.

VI. Diseases of the œsophagus.

VII. Diseases of either of the important nerves traversing the chest.

VIII. Diseases of the diaphragm.

IX. Diseases encroaching upon the thoracic cavity from the abdomen or from the neck.

The particular diseases comprehended within most of the groups just mentioned are very numerous, and they will be found described in their respective articles. Affections connected with the chest constitute a large proportion of the cases which come under observation in practice. This will be readily understood when we remember that the thorax encloses organs essential to life, which are never at rest, and which are constantly more or less exposed to influences liable to injure them. They may be mere *functional disorders*, and to these the heart is especially prone; but serious *organic diseases* are also exceedingly common, and rank very high as causes of death. Moreover, they may either come under the category of *local* affections, though even then they frequently depend upon some cause acting through the general system, such as exposure to cold or wet; or they arise in the course of some *general* malady. For instance, pulmonary complications are of common occurrence in connexion with fevers and various other diseases; the heart is implicated in a large proportion of cases of rheumatic fever; and malignant disease is not infrequently manifested by a local development of cancer in connexion with certain of the thoracic contents. The structures within the chest have an important mutual influence upon each other; and they may also be affected, either directly or indirectly, in connexion with local diseases involving other parts of the body, such as the abdomen or the central nervous system.

CLINICAL INVESTIGATION.—It may be confidently affirmed, that the means which we now possess for investigating diseases connected with the chest are so adequate and precise, that anyone possessing the requisite knowledge and skill, and who carries out the clinical examination properly, can, in the very large majority of cases, arrive at a diagnosis with certainty and practical accuracy. At the same time it must be remembered that every complaint referred to this region, however trivial it may appear to be, does require systematic and thorough investigation, otherwise very serious mistakes are constantly liable to be made. Moreover, chest-cases do come under observation occasionally which are obscure, and which may call for repeated examination before a correct diagnosis can be formed; and exceptional instances occur in which no satisfactory conclusion can be arrived at. The previous general condition of the patient, the hereditary history, and the account given of the origin and progress of the illness, often afford signal aid in the diagnosis of chest-affections, and ought never to be overlooked. The symptoms to which these affections give rise are necessarily various. Pain or other morbid sensations are very commonly complained of, but only in a comparatively few instances are these at all significant, and they can never be positively relied upon in making a diagnosis, while they are often absent in diseases of the most serious character. The important organs, namely, the lungs and heart, usually present more or less disturbance of their functions when they are affected, but grave diseases may exist without any such evidence. The different structures within the chest have a mutual influence upon each other, and thus other symptoms besides those connected with the part actually diseased are often apparent. For instance, the lungs and heart are thus very intimately associated; while aneurysms or growths often disturb these organs seriously, or interfere with the air-tubes, nerves, veins, and other structures. In consequence of more or less interference with the circulation, various symptoms in parts remote from the chest are frequently originated; and distant organs may become the seat of organic lesions as the result of long-continued mechanical congestion, a new train of symptoms being thus set up. The general system may be in this manner affected; whilst pyrexia, wasting, and other general symptoms are often associated with chest-diseases. Lastly, morbid conditions within the thorax may directly affect the abdominal organs; or may actually make their way through the diaphragm into the abdominal cavity.

Physical examination constitutes an essential and most important part of the clinical investigation of the chest and its contents. Indeed, without such examination no certain and exact diagnosis can ever be made. This subject is fully discussed in other appropriate articles, and here it need only be mentioned that the methods of examination which are usually required, and which should in every case be practised, are:—1. *Inspection.* 2. *Palpation.* 3. *Percussion.* 4. *Auscultation.* Other modes which may be called for include:—5. *Measurement* (not uncommonly). 6. *Succussion.* 7. The use of *special instruments*, directed to the investigation of particular organs, such as the spirometer, the stethometer, cardiograph, sphygmograph, aspirateur, œsophageal bougie, &c. *See* PHYSICAL EXAMINATION; and the articles relating to the several organs.

FREDERICK T. ROBERTS.

CHEST, Deformities of.—Under this head are included all deviations in shape from the normal chest.

Deviations from the shape of the typical thorax are appreciable by careful physical examination. Of the various methods employed for this purpose, by far the most valuable are inspection and palpation. Although in some few cases it may be important to determine the exact amount of deformity by mensuration, there are very few deviations in shape or size of the thorax, the degree of which cannot be sufficiently estimated for clinical purposes by the eye and hand, without the aid of any special instruments for measuring.

Deformities of the chest may be due either to abnormity of the parietes, or to disease of internal structures.

DESCRIPTION.—Deviations from the form or size of the typical thorax may be either *general* or *local*—that is, the abnormity may involve the whole thorax, or a part only.

I. General Deformities.—1. *General Diminution.*—The chest may be too small—that is, diminished in all its diameters without being in other respects deformed. Diminution of the thorax simultaneously and uniformly in its antero-posterior and lateral diameters is effected mechanically by an increase in the obliquity of the ribs. The smaller the chest (having regard to the height of the person) the more obliquely are the ribs arranged, and the more acute the angle formed between each of the true ribs (excepting the first) and its cartilage. The intercostal spaces of the true ribs are widened about the junction of the ribs with their cartilages, and at the same time the ribs posteriorly are approximated more closely to each other, the closeness of the approximation being in proportion to the diminution in the size of the thorax. The vertical diameter of the thorax is lessened by an increase in the height of the arch of the diaphragm. The very oblique position of the false ribs, and the height to which the diaphragm rises into the chest, cause several of the false ribs to lie in contact with the diaphragm, and thus no portion of lung is under these ribs. They are, practically speaking, no longer part of the chest-walls. The costal angles are diminished in proportion to the diminution of the size of the thorax—that is, to the obliquity of the ribs. The obliquity of the ribs also causes the shoulders and the sternal ends of the clavicles to droop, and at the same time to incline forwards; the upper part of the scapula is carried by the shoulder forward, the inferior tilted backward.

General and symmetrical diminution in the size of the thorax has one and only one cause, namely, small size of the lungs. Small lungs may be congenital, due to original conformation; or the consequence of atrophic degenerative changes incident to age. In both these cases the lungs are, in relation to the length of the ribs, disproportionately small, and, as a necessary consequence, the relatively too long ribs are arranged more obliquely than they are in a well-formed chest, and the diaphragm is pushed by the abdominal organs higher into the thorax. When the small size of the lungs is due to atrophy, the supra-clavicular fossæ are deepened and the vertical diameter of the chest proportionately diminished. In advanced life the congenitally small lungs are frequently reduced still further in size by the supervention of atrophous emphysema. The congenitally small lungs with the consequently small chest is one of the characteristics of tuberculosis—that is, of that congenital organisation in which tubercle is likely in subsequent periods of life to occur. Atrophous emphysema is especially common in those who have either manifested symptoms of tubercle in their youth, or belong to tubercular families. It is the congenitally small lungs of childhood which are prone to become the seat of tubercle in youth, and the subjects of atrophous emphysema in old age.

2. *General Enlargement.*—The thorax may be too large, increased in all its diameters, without being otherwise deformed. It is simply bigger than it should be, having regard to the height of the subject.

When the thorax is abnormally large, the ribs, instead of being more obliquely situated than natural, as they are in the small thorax, are placed more horizontally than they are in the normal thorax. The angle formed between each rib and its cartilage is greater than in health; while the intercostal spaces, especially the lower, are widened, and the ribs less closely approximated, the arch of the diaphragm is lessened in depth, and a considerable mass of lung lies under the lower false ribs, between them and the diaphragm. The chest is increased in all its diameters. The shoulders are raised. The costal angles are greater than natural.

Increase in the size of the whole thorax has but one cause, namely, increase in the size of the lungs. Increase in the size of the lungs generally, and pretty uniformly, is the consequence of disease, and of one disease only, namely, large-lunged or hypertrophous emphysema. When the increase in size of the thorax attending large-lunged or hypertrophous emphysema is moderate in degree, this is effected by the altered position of the ribs; but when the lung-disease is extreme, then a certain amount of the enlargement is caused by pressure on the inside of the chest during the violent expiratory efforts of severe cough.

3. *Irregular General Deformities.*—In the deformities above described the antero-posterior and the lateral diameters retain more or less perfectly their normal proportion—both are increased or both are diminished; in the former case the chest is on the whole more barrel-shaped than natural, but the deviation from the normal form is not considerable. If, however, the chest-walls are from any cause unduly soft or unduly rigid, then the actually or relatively soft portions will recede during each inspiratory act, and local deformity of the chest follows. The diameter of the chest at the part where the absolutely or relatively soft portion of the parietes is placed will be diminished. The special deformities of the chest which result are due, therefore, primarily to the state of the parietes, and are not, as those previously described, secondary to conditions of the lungs themselves.

a. Diminution in the antero-posterior diameter of the thorax.—The antero-posterior diameter of the thorax is frequently less than that of the normal thorax, the lateral diameter being proportionately increased. The chest has an oval form—it is flattened from before backwards.

The thorax flattened from before backwards is usually associated with small lungs, but the mechanical cause of the flattened form is the want of full resisting power in the ribs and considerable strength in the cartilages. These conditions of thorax are common in the subjects of tuberculosis.

The flattening of the thorax is increased by all impediments to the free passage of air through the air-tubes. In some children suffering from even slight bronchial catarrh, the flattening of the chest is seen to be increased at each inspiration; and if the impediment to the entrance of the air to the pulmonary tissue be constant or extreme, not only is the flattening increased at each inspiration, but the sternum is also depressed, especially at its lower half, below the level of the costal cartilages, and thus the antero-posterior diameter of the thorax is still further diminished in the median line.

b. Increase in the antero-posterior diameter of the thorax.—In rickets the cartilages of the ribs are very firm, whilst the ribs themselves are softer than natural, and especially so near to their enlarged growing ends—the softest part of the ribs; that is to say, just outside the nodule formed at the spot where cartilage is in the process of growing into bone. The consequence of the extreme softness of the ribs at this part is that at each inspiration the weight of the atmosphere presses inwards the softest part of the ribs, while the sternum is borne forward by the firm cartilages. The result is great increase in the antero-posterior diameter of the thorax, and diminution of the lateral diameter at the parts corresponding to the softest part of the ribs. The depression of the softest part of each rib is increased by the want of resilience of the softened structures.

A groove is thus formed in the thoracic walls just posterior to the rickety nodules; and this groove being deepened at each inspiration, the part of the lung adjacent is compressed in place of being expanded during the inspiratory act. At the same time, in consequence of the cartilages and sternum being thrust forward at each inspiration, air enters with undue force into the lung-tissue subjacent to these parts. The consequence of the excessive expansion of the anterior part of the lung is vesicular emphysema, and the recession during inspiration of the softened and imperfectly resilient and therefore deeply grooved part of the chest-wall leads to collapse of the subjacent pulmonary tissue; and, as the effect of these two conditions, the lungs, when the chest is opened, present a vertical groove corresponding to the groove in the chest-walls. The antero-posterior diameter of the thorax in rickets is still further increased by the curvation of the spine. The muscles are weak, the child is unable to sit upright, that is to say it is unable, in consequence of the weakness of its muscles, to support the weight of the upper part of its body; the bones of the spine are, in common with the other bones of the body, softened; and the result of the weakness of the muscles and the softness of the vertebræ is the dorsal bow.

When deformity of the chest is the result of undue softness of the chest-walls, the position of the solid organs subjacent to the parietes is frequently perceptible to the eye. The liver supports the lower ribs on the right side, the heart supports the ribs and cartilages over it on the left side, and thus these organs cause local prominence of the chest-walls, without being themselves in any way abnormal.

In the so-called *pigeon-breast*, the antero-posterior diameter of the thorax is increased in the middle line, the lungs are small, the ribs and cartilages are firm, the ribs are placed obliquely and the chest-walls are flattened laterally, and the sternum as a consequence is thrust forwards; thus the chest in the pigeon-breasted has a triangular form, the apex of the triangle being the sternum. Impediment to the free entrance of air into the lower lobes of the lungs will favour the production of and increase the deformity. The chests of children who suffer from repeated attacks of bronchitis, but are otherwise healthy, are commonly the subjects of this deformity, while there is increased expansion and subsequent enlargement of the upper part of the chest, the lungs being more or less collapsed below and emphysematous above.[1]

c. Transverse anterior constriction of the lower part of the thorax is the consequence of small size of the lungs, or of imperfect inspiratory expansion, permanent or frequently recurring in youth. In these cases the lower ribs are little used in respiration, while below they are borne outwards or supported by the liver, stomach, and spleen, and thus an imperfectly formed transverse depression is produced in the front of the chest on a level with the base of the ensiform cartilage.

The deviations from the type of the normal thorax hitherto described are bilateral, and more or less symmetrical.

II. Local, Unsymmetrical, and Unilateral Deformities.—1. *Fulness of the supraclavicular region.*—The supraclavicular region, corresponding to the portion of the thoracic cavity above the clavicle, may be fuller than natural. The causes of this local bulging are—*a.* Development of adipose and cellular tissue. *b.* Distension of the deep-seated veins. *c.* Large-lunged emphysema, in which disease there is occasionally distension of that part of the cavity of the thorax which lies above the level of the clavicle. The distension is due to pressure on the inside of this part of the thoracic cavity; air being forced violently into the corresponding part of the lung during the powerful expiratory effort of cough.

2. *Depression of one supraclavicular fossa* is caused by any pathological condition of the apex of the lung which produces diminution of its bulk, for example, atrophous emphysema, or chronic consolidation of the apex.

3. *Elevation of one shoulder.*—Occupation is a common cause of elevation of one shoulder; thus in clerks, who sit much at the desk, the left shoulder is permanently a little higher than the right, and the upper portion of the spine is slightly curved, the convexity being to the left; so in those who carry heavy weights on one arm, the opposite shoulder is elevated and the spine curved. Whatever necessitates an increase in the capacity of one side of the thorax causes elevation of the shoulder on the same side; thus, considerable dilatation of the heart, fluid in the pericardium, fluid in the pleura, aneurysm of the arch of the aorta or of the innominate, all lead to elevation of the shoulder. The shoulder is depressed and carried forward when, from any cause, the whole or upper part of one side of the chest is diminished in size, as when the apex of the lung is the seat of chronic pneumonia or chronic phthisis.

4. *Uniform dilatation of one side* of the thorax is due, with one exception, to fluid or air in the pleura. The exception is those rare cases of encephaloid cancer of the lung, in which the formation of cancer is uniformly diffused through the lung-tissue, and in amount so great that the lung 'infiltrated' with cancer very decidedly exceeds in bulk the healthy lung inflated with air by inspiration.

In uniform dilatation of one side of the thorax, the shoulder is raised, the ribs are placed more horizontally than on the healthy side, the intercostal spaces are widened, and the spine is slightly curved. When the enlargement is moderate in amount, the increase in capacity is effected by the altered position of the ribs; but when the increase in size is very considerable, then it is due in part to the pressure exercised by the air, fluid, or cancer-loaded lung on the inner side of the chest-wall.

5. *Uniform contraction of one side* of the thorax is the consequence of any pathological condition which leads to general and uniform reduction in the size of the lung, such as cirrhosis of the lung, infiltrated cancer of the lung, chronic tubercular disease of the lung, chronic pneumonia, or the change in the texture of the lung which follows long-continued compression by fluid in the pleura. When the whole of one side of the thorax is reduced in size, the shoulder on that side is depressed, the ribs are placed more obliquely and are more closely approximated than on the opposite side, the intercostal spaces are narrowed, and the spine is curved, often considerably, the concavity of the curve being towards the contracted side.

6. *Lateral curvature of the spine*, instead of being the consequence, may be the cause of deformity of the thorax: the ribs are then approximated on the side and at the part where the concavity of the curvature is placed, while they are separated and the shoulder is raised on the side of the convexity.

7. In *angular curvature of the spine* the deformity of the thorax varies with the seat

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[1] Nurses should be taught not to compress the chest laterally when carrying a child.—Editor.

and the extent of the vertebral disease; but, speaking generally, it may be said that in angular curvature of the spine the antero-posterior diameter of the thorax is increased in proportion to the amount of destruction of the bodies of the vertebræ, and that the ribs are in a corresponding degree approximated.

8. *Extreme depression of the lower part of the sternum* is the consequence of softness of the cartilages of the ribs, and impediment to the free passage of the air to the pulmonary tissue. This deformity is never congenital, although the subjects of it often affirm it to be so; it may, however, commence to be formed directly after birth if there be a congenital impediment to the entrance of air into the lungs—for example, atelectasis.

This deformity may be the result of direct pressure. In certain occupations pressure has to be exerted on the lower part of the sternum—thus, some shoemakers use a wooden instrument which has to be kept in its place by pressure against the lower part of the sternum. For direct pressure to produce this deformity it must have been applied in early youth, while the parts are still flexible, and have been exerted frequently over a long period of time.

9. *Congenital deformities* of the thorax are few in number and are due to arrest of development—for example, cleft sternum, and defective formation of one or more ribs or cartilages.

10. *Unsymmetrical diminution in size of a part* of the thorax is produced by any pathological change which reduces the size of the subjacent part of the lung. All chronic inflammatory or congestive conditions of the apex of the lung, whether primary or the consequence or the concomitant of the formation of tubercle, are attended by diminution of the bulk of the part of the lung which is the seat of the lesion. Considerable loss of pulmonary tissue is usually accompanied by falling inwards of the chest-wall over the cavity.[1] The formation of a cavity is almost invariably attended by chronic inflammatory condensation, and this increases the local depression of the chest-wall. In chronic thickening of the pleura, the chest-wall at the part is, by the contraction of the fibrin, drawn inwards, and the lung subjacent to the thickened pleura being condensed, the chest-wall is also forced in during inspiration by atmospheric pressure. Hence, after pleurisy limited in extent it is common to find permanent flattening of the thoracic parietes at the base of the chest on the side affected.

In cancerous infiltration of the lung, limited in extent, the lung-tissue is sometimes so much condensed that the bulk of the cancer and lung are less than that of the healthy lung, and the chest-walls as a consequence are flattened over the seat of disease.

11. *Unsymmetrical localised bulging.*—If the ribs are, in relation to the size of the lungs, disproportionately long, and their cartilages soft, then one or more of the cartilages may be knuckled forwards; the cartilage, being compressed between the end of the rib and the sternum, bends in an angle outwards. Although the prominence is trifling, it often causes anxiety to parents and its subject. Local deformity of this kind is occasionally the result of repeated lateral compression of the chest-wall in the athletic sports of young boys, such as cricket.

All the diseases of the chest which are accompanied by general enlargement of both or one side of the chest, when localised, are attended by local bulging; thus, a common cause of abnormal fulness of the lower part of the left side of the thorax, posteriorly, is emphysema of the corresponding part of the lung; and a moderate amount of fluid in the pleura is attended by fulness of the lower part of the chest on the same side. In both these cases the ribs are raised into an abnormally horizontal position; the chest-walls are not pushed outwards, but the ribs are raised, and the intercostal spaces are to that extent widened. The ribs are put into the position which gives the greatest capacity to the thoracic cavities containing the fluid or the enlarged lung. Local bulging may be produced by aneurysm of the arch of the aorta or of the innominate artery; by growths, malignant or other, within the chest; by chronic pleurisy with effusion circumscribed by dense false membrane; by hydatids; or by abscess; and in all these cases the prominence is due to direct pressure on the inner side of the chest-wall, and to changes in the chest-wall itself.

Hypertrophy and dilatation of the heart and fluid in the pericardium are attended by fulness of the præcordial region. The bulging from these diseases is much greater in the child than in the adult. In these cases a little of the fulness is produced by a more horizontal arrangement of the ribs; but when the prominence of the præcordial region is at all considerable, it is the result of the pressure exercised by the fluid or by the large and powerfully acting heart on the inner surface of the corresponding part of the chest-wall.

At the part corresponding to the junction of the first and second bones of the sternum, opposite the cartilage of the second rib, the sternum projects forward. This prominence is called the angle of Ludovicus. Any impediment to the free entrance of air into the lungs may cause depression of the lower part of the sternum; if the ossification of the sternum is not complete at the junction of the first and second bones, undue prominence of this part is the result. Subsequently a formation of bone takes place at this spot, and increases the prominence.

William Jenner.

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[1] It is said that a very large air-containing cavity may give rise to local bulging.

CHEST, Examination of.—*See* PHYSICAL EXAMINATION.

CHEST-WALLS, Deformities of.—*See* CHEST, DEFORMITIES OF.

CHEST-WALLS, Morbid Conditions of.—The walls of the chest may be the seat of various morbid conditions, and the affections of this portion of the framework of the body demand more attention than they are accustomed to receive. All that can be done within the limits of this article is to indicate their nature; to notice briefly such of them as are not described in other parts of these volumes; and to point out the principles of treatment. They may be practically considered according to the following arrangement:—

1. **Superficial Affections.**—Under this group are included morbid conditions of the skin and subcutaneous structures. (*a*) Cutaneous eruptions are of common occurrence over the chest. Among these may be specially mentioned the eruptions of some of the exanthemata, herpes zoster, and chloasma. (*b*) The superficial vessels are liable to become enlarged under certain circumstances. This enlargement is usually seen in the veins over the front of the thorax, which may be distended on both sides, or only on one side, or in some particular region. The larger divisions may alone be involved; or a more or less extensive network of smaller veins is visible, and occasionally even the capillaries seem to be implicated. This condition generally arises from some obstruction interfering with the circulation through one or other of the principal veins which, either directly or indirectly, receive the blood from the veins of the thoracic wall. Thus the superior vena cava, or either innominate, subclavian, or axillary may be implicated, being, for example, pressed upon by new-growths or enlarged glands, the distribution and extent of the venous distension varying accordingly. Occasionally one of the smaller veins is thus interfered with. The writer has met with cases in which considerable enlargement of the veins was visible over portions of the thorax, where the cause was by no means evident, the patients asserting that this condition had existed ever since they could remember, and being regarded by them as perfectly normal. Probably it has resulted from some local obstruction occurring during early life. It must be remembered that women who are suckling frequently present considerable enlargement of the superficial veins over the front of the chest, which usually subsides when the period of lactation is at an end, but may become permanent after several children have been nursed. Again, more or less venous and capillary engorgement in this region may occasionally be observed in cases of cardiac or pulmonary disease. Sometimes a ring of enlarged veins and capillaries is seen round the lower part of the chest. When the venous distension is due to obstruction of the vena cava superior, the skin presents a more or less marked cyanotic tint; and in cases of general cyanosis, the chest, in common with other parts, may have a cyanotic appearance. Occasionally one or other of the small arteries which supply the thoracic walls is enlarged, and it may attain a considerable size. (*c*) Subcutaneous œdema is sometimes observed over the chest. In most instances this is a local condition, being the result of venous obstruction; but it may be a part of general dropsy, particularly in connexion with renal disease. This morbid state is evident on inspection and palpation, and the affected part pits on pressure. (*d*) The thorax is one of the most common seats of subcutaneous emphysema, in which gas, consisting usually of air which has escaped from the respiratory apparatus, collects in the cellular tissue, and travels, to a greater or less extent, over the body. The causes of this condition are described elsewhere (*see* EMPHYSEMA, SUBCUTANEOUS). Subcutaneous emphysema is attended with evident swelling of the part, which usually develops rapidly, and may be very great, all the normal anatomical outlines being obliterated. It has an elastic feel, and pits readily on pressure with the finger, but speedily rises again; the peculiar minutely crepitant sensation accompanying this condition is elicited on palpation and percussion; percussion yields a curious, superficial, muffled, tympanitic sound; and on auscultation a superficial small, dry, crepitant sound is heard. (*e*) As belonging to the superficial affections of the chest may be just mentioned diseases of the mammary gland or nipple, which of course constitute a most important class of diseases in females. *See* BREAST, Diseases of.

2. **Muscular and Tendinous Affections.**—(*a*) The muscles of the chest or their tendinous attachments may be the seat of certain painful affections. These are of the nature of so-called muscular rheumatism or myalgia, of inflammation, or of more or less injury or strain; being induced by cold, constitutional conditions such as gout, overwork, straining, violent coughing, fatigue from prolonged sitting, and other causes. The painful condition is usually localised, but different muscles are involved in different cases, sometimes those which are superficial being affected, in others the deeper muscles, including the intercostals; or the complaint may be confined to a single muscle. Pleurodynia, dorsodynia, and scapulodynia are the terms applied to muscular rheumatism affecting the side of the chest, the upper part of the back, and the scapular regions respectively. As the result of severe coughing, muscular pains are very common around the lower part of the chest. The pain is usually more or less aching in character, and not severe, but it may be very intense, especially in acute cases. Whatever

brings the affected muscles into play aggravates the suffering, such as moving the arms or shoulders when the superficial muscles are affected, coughing, sneezing, and similar actions. In some instances the pain is not felt when the affected structures are kept quite at rest. There may be local tenderness on pressure, or diffused pressure may give relief; while posture often influences the sensations experienced, such as whether the patient assumes the recumbent or sitting posture, or lies on one or other side. Fatigue generally increases the pain. Muscular affections connected with the chest are not necessarily accompanied with any other local symptoms; and physical examination reveals nothing, except that perhaps the act of breathing is voluntarily restrained, on account of the pain thus induced. (*b*) The muscles of the chest may be affected, on the one hand, with spasm or cramp; on the other, with paralysis. The former is attended with more or less pain, usually localised, which may be very severe; the latter is indicated by loss of power in the muscles involved. These disorders generally depend on some lesion of the central nervous system, but may result from local nerve-disease. Muscular cramp may arise from a sudden twist of the body, and it is usually supposed to be the cause of the 'stitch' in the side brought on by running, but this is doubtful. In cases of hemiplegia from cerebral mischief, the muscles of the thorax on the affected side are often temporarily weakened, but they usually subsequently soon regain their power. When the upper part of the spinal cord is injured or diseased at a certain point, all the muscles of the chest become paralysed, which is a very serious matter, as respiration and the acts connected therewith cannot be carried on, except by the diaphragm, and consequently the blood is imperfectly aërated, secretions accumulate in the lungs, respiratory paralysis follows, and the patient dies of apnœa. (*c*) Atrophy or degeneration may involve more or less of the thoracic muscles. In cases of pulmonary phthisis either the whole of these muscles or certain of them are not uncommonly wasted out of proportion to the general emaciation. They may also be implicated in progressive muscular atrophy; and occasionally a single muscle undergoes marked wasting. The writer has seen a striking example of this local atrophy in connexion with the pectoralis major, but the serratus magnus or other muscles may be implicated. The wasting is probably in most cases due to disease of the nerves supplying the affected muscles. It is quite evident on examination, and the movements which are usually performed by the involved structures cannot be executed properly. (*d*) On the other hand, the chest-muscles may become hypertrophied. This may be a natural result of athletic exercises and training; or it may occur in consequence of their being called upon, either habitually or at intervals, to act excessively, as in cases of emphysema or asthma. In exceptional instances the condition known as pseudo-hypertrophic muscular paralysis has extended up to the chest. (*e*) The thoracic muscles not uncommonly present marked irritability under percussion or friction. This has been regarded as an important sign of phthisis; but the writer has often found it equally if not more evident in cases where the lungs were perfectly healthy. (*f*) As the result of injury and other causes, some portion of the muscular structures of the chest may be lacerated, ruptured, or perforated, either alone or along with other structures. This condition will be further alluded to presently.

3. **Nervous Affections.**—(*a*) Neuralgia is very common in different parts of the chest, especially in the side, and particularly the left side—*intercostal neuralgia.* The pain is localised, being usually referred to a point where a branch of nerve becomes superficial. It is more or less constant, in some cases being at times very severe. It often precedes or follows an eruption of herpes. It may be increased by deep breathing or coughing, but is not, as a rule, so much affected by these and similar actions as are other painful chest-affections. Shooting and darting sensations often radiate from the principal point, and certain spots of tenderness—*points douloureux*—may be recognised (*see* INTERCOSTAL NEURALGIA). (*b*) Intercostal neuritis is occasionally met with, and this affection is attended with great pain, localised and radiating, with much tenderness, the suffering being aggravated by whatever causes any local disturbance. It is probable that the severe pains experienced in some instances where the complaint is supposed to be muscular, are due to branches of nerve being inflamed. Severe pain often precedes or follows herpes zoster, and this probably depends upon actual nerve-changes. It may also be mentioned here that pains around the sides may be associated with disease of the spine, or of the spinal cord. (*c*) Some individuals, especially females, exhibit a remarkable superficial tenderness or hyperæsthesia over the thorax or in parts of this region, especially the anterior and upper portions. The slightest touch is resented, and the most delicate percussion cannot be borne. This condition may exist without any actual disease, or it is sometimes observed in phthisical cases. (*d*) Sensation may be more or less impaired over the chest, or in limited portions, either in connexion with central or local nervous disease, or in hysterical and neurotic persons. Various paræsthesiæ are also frequently referred to this region by the class of individuals just mentioned.

4. **Diseases of the Bones or Cartilages.**—The morbid conditions which may be referred to the bony and cartilaginous

framework of the thorax are as follows: (*a*) The chest-walls are often unduly rigid and firm, owing to an excessive deposit of calcareous matter in the sternum and ribs, with ossification or petrifaction of the cartilages. This is a normal condition in old people, being one of the degenerative changes to which they are liable, but it also occurs not uncommonly in younger individuals, as the result of hard work, or excessive athletic exercises, or in connexion with certain pulmonary diseases. This state of rigidity interferes more or less with the respiratory movements, and not infrequently causes serious embarrassment. (*b*) On the other hand, the ribs and cartilages may be deficient in firmness, and consequently too yielding and elastic. This is observed in children and young persons who are ill-nourished, but especially in connexion with rickets, and it becomes a condition of great moment when any disease sets in which causes obstruction to the entrance of air into the lungs, such as bronchitis. The chest-walls are then liable to fall in more or less during the act of inspiration, and may become permanently deformed, 'pigeon-breast,'[1] 'rickety,' and other abnormal forms being thus originated (*see* Chest, Deformities of). (*c*) Acute or chronic periostitis or perichondritis is sometimes observed in connexion, respectively, with the sternum or ribs, or with the cartilages. The acute affection gives rise to limited pain and tenderness, which may be accompanied with superficial redness and swelling, and may simulate some more serious disease. The chronic complaint usually assumes the form of a node, being the result of syphilis. The writer has occasionally observed a small swelling at the junction of one of the ribs with its cartilage, painless, unaccompanied with redness, but with fluctuation. (*d*) The bony and cartilaginous structures themselves may be the seat of disease in some part of the chest, and here must be included the portion of the spinal column which limits this region posteriorly. Thus there may be acute inflammation, caries, necrosis, or so-called scrofulous disease. Among the more important causes which may originate these conditions are injury, syphilis, scrofula, empyema opening externally, and thoracic tumours or aneurysms growing outwards. They may lead to serious consequences, both local and general, and frequently cause more or less deformity of the chest. (*e*) Permanent thickening and distortion of portions of the ribs occur after fractures which have united improperly.

5. **Inflammation and Abscess.**—It is expedient to make a separate group of those cases in which inflammation, resulting in the formation of one or more abscesses, occurs in some portion of the soft structures entering into the construction of the chest-walls. This may be of local origin, arising from injury, bone-disease, or other causes; or it may be due to the opening of an empyema into the tissues; to suppuration extending and burrowing from the axilla or other parts; or to pyæmia. If deep-seated, an abscess may be difficult to detect with certainty, but usually the signs of this condition become sufficiently obvious. Sinuses or fistulæ may be left as a consequence of suppuration in the chest-wall, especially when pus makes its way outwards from within.

6. **Tumours and New-Growths.**—These morbid conditions also demand brief notice. They may be connected with any of the structures of the chest-walls, and are of various kinds; among those which have come under the writer's notice may be mentioned molluscum, fatty growths, cystic tumours, enlarged sebaceous glands, and infiltrated carcinoma. Tumours may make their way inwards from the chest-walls, encroaching upon the cavity of the thorax; or, on the other hand, the walls may be involved by growths extending from within. It need scarcely be mentioned that mammary tumours constitute a distinct, and by far the most important group associated with the structures covering the chest. *See* Breast, Diseases of.

7. **Perforations and Ruptures.**—The muscular structures of the thoracic wall may be more or less destroyed in some part, either by sudden rupture or gradually, allowing a hernial protrusion of the lung to take place between the ribs. As already noticed, empyema may make its way externally through the chest-wall. Aneurysms and tumours extending outwards from within the thorax frequently cause serious destruction of the tissues, including the bony and cartilaginous, as well as the soft structures. This destructive process is often attended with severe pain and suffering, and leads to grave mischief. Congenital clefts or more extensive deficiencies are sometimes met with in the sternum or other parts of the thoracic walls.

8. **Variations in Form and Size.**—The chest often presents deviations from the normal shape and size, and these are so important that they demand separate consideration. *See* Chest, Deformities of.

Treatment.—In many cases where the chest-walls are in a morbid state, they either do not need any special treatment, or no treatment can be of any avail. The chief circumstances under which the practitioner may be called upon to interfere, and the measures to be adopted, may be briefly indicated as follows:—

(*a*) Painful affections of the chest-walls, depending upon conditions of the muscles or nerves, frequently demand local applications for their relief. Thus in different cases it may be requisite to employ hot fomentations, dry heat, or cold applications, in the form of wet rags frequently changed, ice, or evaporating lotions; or to use anodyne applications of various kinds, such as belladonna plaster or liniment, opium plaster or liniment, oleate of morphine, tincture or liniment of aconite, or ointment of aconitine or of veratrine. Anodynes may also sometimes be added to fomentations with advantage. Friction is often of much service, and at the same time stimulating liniments may be employed, such as one containing camphor, chloroform, or turpentine. For ill-defined muscular pains about the chest, which are frequently complained of, free douching with cold water every morning, followed by friction with a rough towel, is often highly efficacious. When pain is localised and obstinate, much benefit may in many cases be derived from the application of a sinapism, mustard-leaf, or even a small blister. In other instances the use of the ether-spray is serviceable, repeated more or less frequently; or sometimes much relief may be obtained from applying over a painful spot a mixture of equal parts of chloroform and belladonna liniment. Galvanism is another agent which may be of the greatest service in relieving painful sensations about the chest, whether connected with the muscles or nerves. Subcutaneous injections of hot water, morphine, or atropine may be demanded in some cases, and constitute a most valuable mode of treatment if pain cannot otherwise be assuaged.

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[1] A condition often produced by pressure of the nurse's hand in holding the child.—Editor.

In the treatment of many painful affections of the chest-walls much assistance may be derived from attention to posture, especially in connexion with certain occupations; from the avoidance of undue fatigue, or of any violent actions which are known to influence this part, such as cough; and from the adoption of measures tending to support the structures, or to keep them in a state of rest. The writer has found great benefit in a large number of instances from strapping the side more or less extensively, in the manner advocated by him for the treatment of pleurisy; and if there is any localised pain, some limited anodyne application, such as a piece of belladonna plaster, may be placed over this spot under the strapping.

(*b*) In many affections of the chest-walls, treatment directed to the general system, or to some special constitutional condition, is often of the greatest service. Thus, in the painful complaints already noticed, there are frequently marked general debility and anæmia; and essential benefit is derived from the administration of quinine, preparations of iron, strychnine, cod-liver oil, preparations of phosphorus, and other tonic medicines, or such as improve nutrition. Some of these are also most useful when there is disease of bone and its consequences. Again, certain affections of the thoracic wall may be associated with rheumatism, gout, or syphilis, and then the particular treatment indicated for these several diseases is called for.

(*c*) When disorders of the muscles of the chest-walls occur, such as paralysis or spasm, associated with some disease of the central nervous system, the treatment must usually be directed to this disease, and but little can be done for the local disturbance. In some instances, however, electrical or other modes of treatment may be of some service, by influencing the action of the muscles, but no definite rules can be laid down.

(*d*) Local inflammation and its results in connexion with the thoracic walls must be treated as in other parts of the body, but it is unnecessary to discuss this subject in the present article.

(*e*) Surgical treatment may be called for under certain circumstances. Of course this will be the case if the chest-walls are injured in any way. Among other conditions likely to demand surgical interference may be specially mentioned subcutaneous emphysema, abscesses, disease of the bones, and tumours. FREDERICK T. ROBERTS.

CHEYNE - STOKES RESPIRATION.—A peculiar disturbance of breathing, first described by the late Drs. Cheyne and Stokes, of Dublin. *See* RESPIRATION, Disorders of.

CHICKEN-POX.—SYNON.: Varicella; Fr. *La Varicelle*; Ger. *Wasserpocken*.

DEFINITION.—An acute specific infectious disease, characterised by the appearance, in successive crops, of red spots, which in the course of about a week pass through the stages of pimple, vesicle, and scab.

ÆTIOLOGY.—The origin of this disorder is unknown. It is certain that it arises from contagion, and that childhood is its predisposing cause. It occurs in children at the breast, and is seen with increased frequency up to the fourth year, at which period it attains its maximum. It is less often found between four and twelve, and after twelve it may be said to disappear, although it is occasionally seen in adults.

SYMPTOMS.—The illness commences without any, or with but slightly-marked, premonitory symptoms. There is usually some feeling of lassitude, and the patient goes to bed earlier than usual. Within a few hours an eruption appears, generally on some part of the back or chest, but there are many exceptions to this rule. It may commence on the face, neck, chest, abdomen, or extremities, or upon several of these parts at the same time. The eruption consists of small, faintly papular rose-spots, varying in number from twenty to one or two hundred. These, in the course of eight, twelve, or, at the most, twenty-four hours from their appearance, change into vesicles, which, at first small in size and clear as to their contents, become quickly large; globular, or semi-ovoid, in form; translucent, glistening, and opalescent in appearance; and surrounded with a faint areola. Towards the end of the second day of illness, the vesicles attain complete development, and about this time a few may be seen on the sides of the tongue, on the lips, cheek, or palate, and sometimes upon the mucous membrane of the genitals. About the third day a few of the vesicles may have a pustular appearance, and sometimes a few pustules are seen; but, regarding the eruption as a whole, pustulation forms an incident rather than an essential feature in its progress. On the fourth day the vesicles begin to dry up, and by the sixth complete scabs are formed. These fall off in a few days, leaving in their place faintly red spots, and sometimes a few pits. A single crop of eruption may be said to complete itself in five or six days; and, as two or three crops appear on as many successive days, the illness will last rather more than a week. In the event, however, of there being four or five crops, it may be prolonged for another week, but this is unusual. With the appearance of the eruption, the temperature rises two, three, or even more degrees, and this rise recurs with each successive crop of spots. The pulse is sometimes slightly increased in frequency; the tongue is moist, and sometimes covered with a light fur. As a rule, however, there is but little constitutional disturbance, although it is occasionally severe.

Pathology.—Chicken-pox is due to the reception of a specific poison, which after an incubation of about thirteen days, shows itself by an eruption upon the skin. What this poison is, how it enters the body, and what, if any, changes it produces upon the internal organs, the present state of our knowledge does not enable us to say. It affects the same individual once only, and it is perfectly distinct from modified small-pox, as the following considerations will show:—1. Chicken-pox is characterised by the *rapidity* with which it runs through its stages; modified small-pox, on the contrary, is characterised by an interruption in the course of the disease at one or other of three points—the papular, the vesicular, or the pustular. 2. The chicken-pox eruption attains complete development by the end of the third day; in modified small-pox, should the eruption attain complete development, this will not occur before the ninth day, however much the disease may be modified. 3. In modified small-pox the premonitory symptoms are usually well-marked, often quite as severe as in the natural disease, and these last forty-eight hours, after which there is an eruption of small hard papules on the forehead, face, and wrists, followed by a *fall* of temperature. In chicken-pox the premonitories are most often wanting, and when present are slightly marked, and the eruption is followed by a *rise* in the temperature. It appears, moreover, upon any part of the body indiscriminately, and less frequently on the face than on other parts; and within a few hours—at the most within twenty-four—it has become vesicular; whereas in modified small-pox the vesicular stage is only reached forty-eight hours after the appearance of eruption. 4. The vesicles of chicken-pox are globular or ovoid in form, without any central depression; glistening or translucent in appearance; and unicellular in structure. They collapse on pricking; and attain their maximum development in from twelve to eighteen hours. Modified and natural small-pox vesicles are flat and circular in form, always depressed in the centre, and sometimes umbilicated, of an opaque dirty white colour, and multicellular in structure. They do not collapse on pricking, and attain their maximum development at the end of the third day from their origin. 5. Small-pox is an inoculable affection; chicken-pox, according to reliable authority, is not. 6. When cases arise which all recognise to be modified small-pox, they are always accompanied by others which are more severe; and in epidemics these latter gradually become more numerous up to a point of maximum intensity, when they decline and the modified forms reappear. In chicken-pox there is no such gradual increase in the intensity of illness, and neither serious nor fatal cases form part of its epidemics, which prevail independently of small-pox. 7. Small-pox and vaccinia are often early followed, in the same individual, say within two or three years, by chicken-pox, and *vice versâ*. 8. Chicken-pox, vaccinia, and small-pox have been known to follow in immediate succession in the same individual.

Course and Termination. — Varicella always runs a favourable course. It has no sequelæ.

Diagnosis.—It should be borne in mind that a sure diagnosis cannot be made in less than forty-eight hours. The appearance, however, of a crop of vesicles, followed on the next day by a second crop, points almost certainly to chicken-pox. Attention to this, and to the points noted under the head of Pathology, ought to make the diagnosis easy.

Prognosis.—This is always favourable.

Treatment.—The patient should be confined to his room, perhaps in the more marked cases to his bed. His food should be that which is easy of digestion; and although no physician has recorded a fatal case, a child whose temperature rose to three, four, or six degrees above normal should be examined with care.

Alex. Collie.

CHIGOE.—Description.—The Chigoe is a minute parasitic insect, common in the West Indies and northern parts of South America. It is also popularly known as the *Jigger* or *Sandflea*. Though formerly regarded as an acarus or mite, it is now generally recognised as a true flea, belonging to the genus Pulex (*P. penetrans*); but several entomologists have advanced solid reasons for separating it from the ordinary fleas. Thus Westwood terms it the flesh-flea, or *Sarcopsylla penetrans*, whilst Guérin formed the genus *Dermatophilus* for its reception. Practically, these distinctions are of little moment.

The Chigoe ordinarily lives in dry and sandy situations, where it multiplies to a prodigious extent. It attacks, however, the feet, chiefly underneath the nails and between the toes; the impregnated females burying themselves beneath the skin. Here the abdomen of the parasite swells to the size of a pea; and, unless removed by operation, gives rise to acute local inflammation, terminating in suppuration and sometimes in extensive ulceration, with even fatal results to the patient. Dogs also suffer excruciating torment from the bites and immigration of the *Bicho do Cachorro*, which, however, Pohl and Kollar regard as distinct from the human jigger (*Bicho de pé*). Be that view correct or not, it would appear from the observations of Rodschild and Westwood that the larvæ of the human chigoe are hatched in the open wounds or ulcers, which sometimes extend inwards so as to involve the bones themselves. In bad cases amputation of the toes and adjacent parts becomes necessary. Left to themselves, the larvæ escape from their host, and probably, after the manner of bots and other parasitic insects, penetrate the soil for the purpose of acquiring the pupal stage of growth. In European practice cases of jigger are rarely seen; nevertheless the writer has recorded an instance in which strong mental delusions followed the torture produced by these creatures. The patient, a middle-aged married lady, had suffered severely during her residence in the West Indies. Although she had got rid of the parasites, she constantly harpooned her own feet in the hope of destroying the young jiggers which she felt sure were still burrowing beneath the skin.

Treatment.—As regards treatment, the indications are simple. The parasite should be removed with the utmost care. Where this has not been done, and where, as a consequence, open sores exist, frequent washings with tepid water, followed by the application of carbolic acid lotions (twenty or thirty grains to the ounce) or of ointments (one drachm to one ounce of benzoated lard) will be found most suitable. Or, again, the carbolic acid putty, as sold in shops, or the application of one part of the acid previously mixed with ten or twelve parts of simple olive oil, will, in all likelihood, be sufficient to cause the destruction of any larvæ that might remain. Lastly, it seems almost needless to say that residents and travellers in Guiana, Brazil, and in the West Indies generally, should have their feet properly protected.

T. S. Cobbold.

CHILBLAIN.—Synon.: Kibe; *Pernio*; Fr. *Engelure*; Ger. *Frostbeule*.

Definition.—A state of inflammation of a part of the skin induced by cold.

Ætiology.—Chilblains are common in children and young persons, and are more frequent in girls than boys. They occur chiefly in those of a lymphatic constitution, and may be considered as an indication of debility and deficient vital power. In adult age they are rare, and are only met with when the powers of the constitution are reduced. Their occurrence is influenced more by the strength of the individual than by the degree of cold, and they continue in some persons throughout the entire year. Their tendency is to cease with the full development of the system, and they reappear occasionally in advanced life.

Description.—The regions of the body usually affected with chilblains are the feet and hands, to which are sometimes added the ears and nose. A chilblain presents three stages or degrees of severity, namely, *erythematous*, *bullous*, and *gangrenous*; and it may be arrested at the first or second stage by the withdrawal of the cause. The *erythematous* stage is restricted to hyperæmia, swelling, and severe burning and itching, the itching being increased by heat, as by that of the fire or that induced by exercise. The congested spot is circular in figure, somewhat tumid, brightly red at first, but later on roseate crimson, purple, or livid in colour. The second or *bullous* stage exhibits the blain or blister resulting from effusion of serum beneath the cuticle; the permanent colour of the swelling is now purple or livid; and the contents of the blister a limpid serum, generally reddened with blood—sometimes, indeed, the fluid of the blister may be semipurulent. In the *gangrenous* stage the blister is broken, the surface of the derma is in a state of gangrene, and the gangrenous layer is subsequently removed as a slough by ulceration.

Treatment.—The treatment of chilblain requires to be modified to suit its different degrees. In the first, the indication is to restore normal circulation by gentle friction, and, when the part is severely chilled, it is usual to rub it with snow: then some soothing liniment may be employed; and, finally, a stimulating liniment, covering the part afterwards with zinc ointment and cotton-wool, or shielding it with lead or opium plaster spread on washleather. The applications most in favour for this purpose are the soap liniment with chloroform and laudanum, the compound camphor liniment, the turpentine liniment, and the tincture of iodine. In the bullous stage a similar treatment may be used to the erythematous portions, whilst the blister should be snipped and the broken surface pencilled with the compound tincture of benzoin, and afterwards dressed with unguentum resinæ or an ointment of Peruvian balsam. In the third stage the erythematous phenomena still require attention, and the ulcer should be dressed with unguentum resinæ, either alone, or in combination with antiseptics.

To obviate constitutional debility, the diet should be nutritious and generous, and recourse may be had to tonic remedies, such as iron and quinine and good air.

Erasmus Wilson.

CHILL.—A subjective sensation of coldness, accompanied with shivering, and most frequently experienced in connexion with febrile or inflammatory diseases, in nervous individuals, and after exposure to cold and wet. In popular language 'taking a chill' is used as synonymous with 'catching a cold,' as from some undue exposure. *See* Rigor.

CHIN-COUGH. — A synonym for whooping cough. *See* Whooping Cough.

CHIRAGRA (χείρ, the hand; and ἄγρα, a seizure).—Gout in the hand. *See* Gout.

CHLOASMA (χλόα, a green herb).—Synon.: Liverspot; Fr. *Ephelide*; Ger. *Leberfleck.*

A pigmentary discoloration of the skin, of a yellowish-brown or liver-colour tint, occurring in blotches, and due to constitutional causes. Its synonym, *ephelis gravidarum*, indicates its occasional association with pregnancy. *See* Pigmentary Skin Diseases.

CHLORAL HYDRATE, Poisoning by.—Synon.: Fr. *Empoisonnement par l'Hydrate de Chloral*; Ger. *Chloralhydratvergiftung.*

Poisoning by chloral hydrate is a very common occurrence, this medicament being frequently taken in fatal quantity by misadventure. There is reason to think that it is also largely used for suicidal purposes. The so-called 'chloral habit' is a growing evil. A syrup containing about twenty-two grains of this substance per fluid drachm is largely and injudiciously sold in this country under a patent-medicine stamp.

Anatomical Characters.—There may be an entire absence of any characteristic appearances after death by hydrate of chloral; and at most these consist in more or less modified signs of asphyxia—especially a dark colour of the blood, and pulmonary and cerebral hyperæmia.

Symptoms.—The most striking symptoms of poisoning by chloral hydrate is the rapid supervention of quiet sleep, at first simulating natural sleep. In this stage the patient can be easily roused, but he speedily drops off again. The pupils are contracted; the respirations are full, deep, and regular; the pulse is not much affected. This condition rapidly deepens into full coma. The respirations slacken; and the pulse is either weak and slow, or, more commonly, rapid and irregular. The temperature of the body is reduced; the muscular system is totally relaxed. The pupils now dilate; and with feeble, thready pulse, the anæsthesia and paralysis gradually end in death, preceded by lividity and collapse. Exceptionally, in fatal cases, burning pain in the mouth, fauces, and throat, and symptoms of gastritis have been observed. In one case of recovery the patient became idiotic. The urine contains an abundance of glycuronic acid.

Diagnosis.—The history of the case, or the finding of a vessel containing the medicine, coupled with the symptoms, will usually set all doubts at rest. Otherwise the case may be mistaken for poisoning by opium or other narcotic, for carbolic acid poisoning, or for cerebral congestion. The pupil is not so contracted as in opium poisoning; and, as the coma deepens, the pupils dilate instead of undergoing further contraction. There is an absence of the olive-green or black urine so commonly noticed in carbolic acid poisoning, of the peculiar odour of the breath, and of stains about the mouth and lips.

Prognosis.—This will depend upon the state in which the patient is found, and upon the length of time which has elapsed since the ingestion of the poison.

Treatment.—Evacuation of the stomach by the aid of the stomach-pump is the first step in the treatment of a case of poisoning by chloral hydrate. Emetics, unless given early, usually fail to excite vomiting. The patient must be roused, if possible, as in opium poisoning (*see* Opium, Poisoning by). The temperature of the body must be kept up by warm applications. Stimulants may be freely given, and hot coffee injected into the rectum. Strychnine ($\frac{1}{25}$ gr.) has been recommended for use as a counter-poison, by subcutaneous injection; also picrotoxin. The former is a dangerous remedy; the latter also would not perhaps be a safe antidote, if given in full doses. Inhalations of amyl nitrite, and artificial respiration are advisable.

Thomas Stevenson.

CHLOROFORM, Use of.—*See* Anæsthetics.

CHLOROSIS (χλωρός, green or sallow). Synon.: Green-sickness; Fr. *La chlorose*; Ger. *Chlorose; Bleichsucht.*

Definition.—A variety of anæmia occurring in a peculiar diathesis or habit of body, which is characterised by defective growth of the blood-corpuscles and vascular system.

The subjects of this diathesis are said to be *chlorotic.* They ordinarily enjoy good health, unless exposed to any of the causes of anæmia, when they readily suffer from aglobulism; and this aglobulism may proceed to complete anæmia. The term *chlorosis* is properly applied to the first and simpler form of anæmia in these subjects; the second and more complex condition is designated *chloranæmia*; or, more commonly, *anæmia. See* ANÆMIA.

ÆTIOLOGY.—Chlorosis occurs most commonly in young women from the age of puberty to twenty-one, but it may appear or reappear up to the thirtieth year; it is found occasionally in children and older women; it is very rare in men. It is believed to be more common in the higher ranks of life. Beyond these predisposing causes, the origin of the disease lies in peculiar characters of the blood and blood-vessels, to be presently described, which are believed to be congenital, and perhaps hereditary. In such subjects, and under the preceding circumstances, any of the numerous causes of anæmia may be sufficient to excite the appearance of chlorotic symptoms; but those which do so most commonly are bodily growth and development, the establishment of menstruation, disturbances of alimentation—particularly constipation, and an insufficient enjoyment of air, light, and wholesome muscular exercise.

ANATOMICAL AND CHEMICAL CHARACTERS.—The blood in chlorosis presents one essential imperfection, as far as our present knowledge extends. The individual red corpuscle contains less than the normal amount of hæmoglobin, the total amount of hæmoglobin in the blood sometimes falling to less than one-fourth. With this defect there may be associated various other abnormalities. The total quantity of blood is below the normal, though there may be an excess in relation to the calibre of the vessels (*plethora ad vasa*). Both red and white corpuscles are sometimes deficient in numbers, and that proportionately. In pure chlorosis the quality of the liquor sanguinis is believed to be unchanged; but it is possible that certain complex organic substances exist in the blood which cannot be discovered by our present methods of examination.

With this condition of blood there are associated certain remarkable abnormalities of the aorta and arterial system generally. The most striking of these is a hypoplasia or dwarfed condition of the aorta, represented by small calibre, increased elasticity, anomalous origin of the branches, and unequal thickness and fatty metamorphosis of the intima. The heart is, as a rule, small in early life; but full-sized or even hypertrophied at a later period, with traces of endocarditis. The blood-glands and lymphatic structures are not diseased. The condition of the ovaries and uterus has been carefully examined in chlorosis and found to vary extremely. In some cases the generative organs are described as 'infantile,' while in others they are either immoderately developed, or perfectly normal in every respect. Corresponding with the aglobulism, the subcutaneous fat is abundant; and the viscera present various degrees of fatty metamorphosis. When the cardio-vascular changes are marked and advanced, there may be extensive secondary disease throughout the body.

SYMPTOMS.—The symptoms of simple chlorosis are those of mild anæmia, with certain important differences which become fewer and less marked, and finally disappear, as chlorosis advances to the more serious disease. The present article will be chiefly devoted to a description and discussion of these.

The appearance of the chlorotic girl is peculiar, inasmuch as the pallor of her complexion is accompanied by natural or even increased fulness, from the excess of subcutaneous fat. At the same time the colour of the skin is so remarkable as to have given its name to the disease, the general hue being a greenish-yellow. In blondes the transparency of the skin is increased; in brunettes it is diminished, and a dull yellowish-grey colour of skin is the result, which, in contrast with the greyish-blue of the eyelids, may appear of a sickly green.

The patient's usual complaint is of this alteration of colour, menstrual disorder, debility, great breathlessness, cardiac symptoms, and various pains. She probably believes that she has heart disease; her mother fears that she is consumptive. Various menstrual disorders are present—namely, premature menstruation, amenorrhœa (with respect both to the period and the amount), occasionally menorrhagia, and leucorrhœa. Breathlessness on exertion is one of the most striking symptoms. The cardiac symptoms and the cardiac and vascular signs closely resemble those of anæmia. But there is this important difference in the phenomena connected with the heart, that in many cases of chlorosis they indicate enlargement, and especially hypertrophy of the left ventricle. The characters of the blood already described are readily discovered by the use of the hæmoglobinometer and hæmacytometer. Venous thrombosis may be found in the legs. The alimentary system is often seriously deranged, constipation being an urgent symptom. The urine is abundant, watery, and pale. There is no dropsy in simple, uncomplicated chlorosis. Rheumatic symptoms are occasionally associated. Pyrexia (99°–103° F.) has been observed in some instances. Optic neuritis may occur.

The *chlorotic constitution or diathesis* may be recognised by the following characters, which are variously associated in different cases:—Diminutive stature; imperfect sexual development; a history of peculiar anæmia in childhood, of anæmia with menstrual irregularity at puberty, and of previous attacks of symptoms of chlorosis; evidence of cardiac enlargement or mitral disease in the absence of all the ordinary causes of these; the occurrence of endocarditis during pregnancy or *post partum*; and the presence of any of the diseases which will be referred to under the head of Complications.

COURSE, DURATION, AND TERMINATIONS.—The commencement of chlorosis is generally gradual, but may be sudden. Its ordinary course is towards confirmed anæmia, in which it may terminate, the liquor sanguinis becoming affected, and wasting and œdema being added to the previous symptoms, which are also aggravated. It is for this reason that pure chlorosis is a rare disease, while anæmia associated with the chlorotic diathesis is comparatively common. The duration of the disease is variable; it rarely declines until the determining circumstances have been removed, and the patient subjected to careful treatment. Chlorosis may reappear in the subject of the diathesis, and that more than once; but the probability of its return is small after the age of thirty, especially in the married woman. Death from chlorosis directly is excessively rare.

COMPLICATIONS AND SEQUELÆ.—According to Virchow, serious valvular disease and cardiac enlargement may be traced in some of the worst cases of chlorosis to the associated vascular condition; and the mitral valve is peculiarly liable to be attacked by endocarditis in rheumatic, puerperal, or septic fever. Hæmorrhages, gastric ulcer, and exophthalmic goître are believed to occur with comparative frequency in persons of the chlorotic diathesis.

PATHOLOGY.—The deficiency of the individual red corpuscle in hæmoglobin, and the deficiency of the blood in red and white corpuscles, indicate an imperfect growth of the red corpuscles and an imperfect production of the cellular elements of the blood. With this blood-state there is undoubtedly associated a hypoplastic or dwarfish condition of the blood-vessels. In the embryo the blood and blood-vessels are developed from the same elements, the former making its appearance within the cells which produce the latter. It is highly probable, therefore, that the anomaly of blood and the anomaly of vessels are to be considered as together an expression of some congenital defect of the blood-vascular system, leading to imperfect growth both of blood and of vessels. Any individual possessing a blood-vascular system thus anomalous labours under a peculiar diathesis, or debility of the corpuscles and circulatory system, and is said to be a *chlorotic subject*, or to possess *the chlorotic constitution or diathesis.*

If the other systems of the body are full-sized (which is not always the case), the dwarfish condition of the arteries of the chlorotic subject and the scanty supply of hæmoglobin may have some difficulty in satisfying the ordinary demands for blood, and especially for oxygen. This difficulty of the blood-vascular system will become a breakdown when the processes of alimentation are deranged from which the blood derives the materials for its maintenance, or when the blood is wasted by the excessive demands of growth, development, or hæmorrhage. Such a result is more likely to happen at periods of extraordinary demand within the economy, of which the establishment of menstruation is the chief. It is in this way that exposure to the causes referred to is sufficient to produce the symptoms of chlorosis, when they might not affect the blood of an ordinary (non-chlorotic) individual.

The symptoms of uncomplicated chlorosis are due to aglobulism or deficiency of oxygen in the system (*see* BLOOD, Morbid Conditions of). When chlorosis advances to complete anæmia, by the implication of the plasma, a new series of phenomena present themselves, prominent among which are loss of flesh and œdema of the extremities.

The cardiac enlargement and valvular disease are directly referable to the vascular hypoplasia, that is, to the obstruction caused by the narrow calibre of the aorta. The connexion between the blood-vascular condition and that of the generative organs is more complex. On the one hand, the chlorotic diathesis or actual chlorosis interferes with the development and activity of the ovaries and uterus; on the other hand, disorders of the sexual functions are occasionally exciting causes of aglobulism.

A variety of suggestions have been offered as to the manner in which derangement of the alimentary processes in the bowels impoverishes the blood in chlorotic subjects. Sir Andrew Clark maintains that when the bowels are inadequately relieved, ptomaines and leucomaines are produced within the intestine and absorbed into the blood, 'where they originate in girls of a nervous type of organisation those alterations of the constitution of the blood which constitute the true pathogeny of this anæmia.' Another suggestion is, that sulphuretted hydrogen generated in the bowels destroys the organic compounds of iron which go to form hæmoglobin. According to a third suggestion, substances containing animal gum, which are developed in excess within the alimentary canal of the girl or woman, being required for the after-nourishment of the embryo, act injuriously on the hæmoglobin molecule. Still another theory is, that, from a deficiency of hydrochloric acid in the system, iron enters the blood in forms which cannot be assimilated by the corpuscles.

Diagnosis.—Chlorosis has chiefly to be distinguished from symptomatic and pernicious anæmia. The points by which the diagnosis may be accomplished have been sufficiently indicated. Leukæmia may be readily recognised by a careful examination of the blood and spleen. *See* also Anæmia, Pernicious.

Prognosis.—The prognosis is highly favourable as regards life; and a speedy cure may be assured in uncomplicated cases subjected to careful treatment.

Treatment.—The success of a particular method of treatment of simple chlorosis is one of the strongest arguments in favour of the correctness of the preceding view of the pathology of the disease. The condition being one of aglobulism, the treatment employed will be so far simpler than that of anæmia, that the red corpuscles alone have to be restored. While the various measures recommended in the more serious blood-disorder are therefore to be employed, if necessary, it will generally be found that iron alone will be sufficient to effect a cure in chlorosis, and that rapidly. The particular form in which the drug is to be presented must be carefully selected according to circumstances. These are fully set forth in the article Anæmia, and need not be repeated here. A free supply of sunlight is essential, and must be insisted upon; and physiological rest of the blood and of the organs of circulation is equally necessary.

J. Mitchell Bruce.

CHOLÆMIA (χολή, bile; and αἷμα, blood). Definition.—This term literally denotes that condition in which the blood contains some or all of the bile constituents which have been secreted by the hepatic cells, and subsequently reabsorbed, either directly by the capillaries or *viâ* the lymphatics. It is usual to include the symptoms which this state induces under the expression 'jaundice,' which is more properly only one of the manifestations of the circulation of a bile-containing blood; and hence the word cholæmia has come to have a more restricted application, corresponding to the *icterus gravis* of older writers, or even to have fallen into disuse.

Symptoms.—The symptoms of cholæmia are very variable in their occurrence and severity. Jaundice is certainly the most constant, and is elsewhere fully treated of. The derangements of digestion, which depend on exclusion of bile from the alimentary canal, are scarcely to be regarded as effects of vitiated blood. But the slow pulse, bitter taste in the mouth, pruritus, cutaneous eruptions, hæmorrhages, wakefulness, yellow vision, and certain nervous phenomena, some or all of which so constantly accompany jaundice, are obviously attributable to this cause.

The explanation of these symptoms is not altogether clear, owing in great part to our ignorance of the intimate nature of bile-secretion, and of the exact share taken by the liver in urea-formation and other metabolic processes. In obstructive jaundice the bile-pigments are soon absorbed from the occluded biliary passages, and are obviously the cause of the icteric discoloration of the skin and tissues. Later the bile-salts are diffused into the blood-current, and doubtless they are responsible for the slow pulse so commonly found in jaundice unassociated with pyrexia, and also for the destruction of blood-corpuscles and consequent petechiæ and other hæmorrhages, since these conditions are well known to follow the artificial injection of bile-salts into the blood. The bitter taste, as also the pruritus, are probably due to the same cause. Whether the various cutaneous eruptions are the expression of the local irritation of a bile-containing blood, or, as is more probable, of some trophic disturbance, determined by the toxic materials acting through the nervous system, cannot be affirmed. The most interesting and important symptoms of cholæmia, to which the term has sometimes been limited, are the nervous symptoms. It is well known that many cases of bile-retention, even of considerable severity, may run a prolonged course, and, except for the jaundice, be almost unaccompanied by other symptoms directly referable to the vitiated blood; but in some, even when the jaundice is but slight or even quite absent, nervous symptoms of a grave character supervene, often with considerable suddenness. The general character of these manifestations is an increasing drowsiness, which deepens into coma, usually fatal. Preceding this, a stage of excitement, with noisy violent delirium, may occur, or sometimes convulsions of varying severity. There is a noticeable absence of headache, in the writer's experience, offering therein a marked contrast to uræmia, with which by some the state now described has been considered identical. The general condition of the patient is that of the 'typhoid state,' with varying degrees of coma or convulsion. With our present knowledge it is extremely difficult to suggest the cause for these symptoms: the prevailing view is that they are toxic, the poison being developed in the body as a consequence of the perverted hepatic functions. But whilst it may be said with certainty that they are not due to accumulation of cholesterin in the blood (cholesteræmia), as was formerly stated, it remains uncertain whether the poisonous material is actually excess of bile-salts, or, what is far more probable, of nitrogenous derivatives of proteid digestion, which, in the normal action of the liver, would be converted into bile-salts or urea. The close relationship existing between the bile-forming and urea-forming functions of the liver should not be forgotten; nor also the fact that the bile is normally one of the most important channels whereby toxic substances are eliminated from the organism, whether these be poisons introduced from without or developed in the liver or other tissue as results of morbid metabolism. The suppression of the biliary secretion or its obstructed excretion readily explains how a blood-poisoning may be engendered, though the exact source and nature of the poison may not as yet be accurately known. Another explanation of these symptoms has been put forward by Cohnheim, who, comparing them to the delirium often seen at and after the crisis of acute diseases, attributed them to cerebral inanition, coupled with an excessive albuminous disintegration in the tissues.

Treatment.—This usually resolves itself into removing the cause of the bile-retention; when this is impossible, but little can be done for the resulting symptoms. The itching of the skin may sometimes be considerably allayed by alkaline baths, or by causing profuse sweating by pilocarpine or hot-air baths. It often subsides independently of treatment, to recur again with increased severity, especially at night. The internal administration of bicarbonate of potassium, a method commonly adopted in jaundice from most causes, also relieves the pruritus. Active diaphoresis, with a brisk purge and blisters to the nape of the neck, are indicated for the cerebral symptoms. Very little benefit appears to follow such remedies as the bromides if given for the convulsive seizures, but leeches to the temples are of occasional service if indicated. W. H. Allchin.

CHOLAGOGUES (χολή, bile; and ἄγω, I move).—Definition.—Substances which lessen the amount of bile in the blood.

Enumeration.—The principal cholagogues are Mercury and its preparations—especially Calomel and Blue Pill; Podophyllum and Podophyllin; Euonymin, Iridin; Ipecacuanha; Aloes; Rhubarb; Sodium Salicylate, Sodium Phosphate, and Sodium Sulphate.

Action and Uses.—The liver has a twofold action—it *forms* bile, which is poured into the duodenum; and it also *excretes* the bile which has been re-absorbed from the duodenum and carried back to the liver by the portal circulation. Much bile thus circulates continually between the liver and duodenum, while part is carried down the intestine with the fæces, and its place supplied by newly formed bile. When the quantity circulating in this way is too great to be completely excreted by the liver, it enters the general circulation and produces symptoms of *biliousness.* These are removed by the so-called cholagogues, which probably act by stimulating the duodenum, and thus carrying the bile so far down the intestine as to interfere with re-absorption. Amongst the best cholagogues are the preparations of mercury, which, with the exception of the perchloride, do not increase the secreting power of the liver, nor augment the quantity of bile formed by it. Their utility is greatly increased by combination with a saline purgative, which still further clears out the intestine, and completely prevents any re-absorption of bile. Other cholagogues, such as podophyllin, rhubarb, and aloes, actually increase the secretion of bile by the liver. At the same time, they probably prevent its re-absorption, in a similar way to mercurials and salines. T. Lauder Brunton.

CHOLELITHIASIS (χολή, bile; and λίθος, a stone).—The condition of system associated with gall-stones. *See* Gall-Stones.

CHOLERA, ASIATIC. — Synon.: Epidemic, Spasmodic, or Malignant Cholera; Fr. *Cholèra Asiatique*; Ger. *Asiatische Cholera*; Ital. *Colera Asiatico.*

Definition.—Asiatic cholera is a specific disease, characterised by violent vomiting and purging, with rice-water evacuations, cramps, prostration, collapse, and tending to run a rapidly fatal course. It is capable of being communicated to persons otherwise in sound health, through the dejecta of patients suffering from the disease. These excreta are most commonly disseminated among a community, and taken into the system, by means of drinking-water, or in fact by anything swallowed which contains the specific organisms passed from cholera patients. In badly ventilated rooms, the atmosphere may become so fully charged with the exhalations from patients suffering from cholera as to poison persons employed in nursing the sick. In the same way, people engaged in carrying the bodies of those who have died from cholera for burial, or in washing their soiled linen, may contract the malady. In a dried condition the organisms contained in cholera excreta may retain their dangerous properties for a considerable period.

Asiatic cholera is endemic in certain parts of British India, where, from time to time, it assumes an epidemic character, and is apt then to spread, through the means above indicated, along the chief lines of human intercourse, and so to extend over the world.

History.—Since the days of Hippocrates, medical practitioners residing in various parts of Europe have described a disease which they called cholera. The nosology of this affection was hardly a matter of doubt with them, and it is only in modern times that the question has arisen, as to whether the cholera commonly met with among us is identical in its nature with Asiatic cholera. Doubtless, if we compare isolated cases we may find that the symptoms which these affections induce are very similar; but those who have lived beyond the endemic area of

Asiatic cholera, and watched the disease spread from India over Europe and America, can scarcely mistake this malignant malady for simple cholera. Asiatic cholera was unknown in Europe before the year 1829–30, although it has existed in India for many centuries. It is true we have no accounts of cholera extending throughout the whole of Hindustan prior to the year 1817, but this arises from the circumstance that it was only at the commencement of the present century that the British Government began to bind the heterogeneous principalities of India into union, and thus render it possible for us to gather together authentic details regarding the disease, as it spread from one province to another.

We cannot here fully consider the relations which unquestionably exist between the rapidity of the diffusion of cholera from the East over Europe, and the increased facilities of communication that have recently been established between India and Persia and Arabia, also from Hindustan to Russia and the shores of the Mediterranean. For instance, sixty years ago the passage from Bombay, up the Arabian and Persian Gulfs, could only be undertaken at certain seasons of the year when the winds were favourable, and even then the voyage was difficult to accomplish; now large steamers run every week from Bombay to Bassorah and the intermediate ports along the Persian Gulf, and others pass with equal rapidity to the various towns bordering the Red Sea. But although we cannot enter further into this subject, we must, in order to appreciate the nature of cholera, glance at the chronological order of some of the principal outbursts of the disease, which have been disseminated from British India over the world.

In 1817 cholera spread rapidly throughout Bengal, extending during the following year over the greater part of Hindustan, and from thence to Ceylon, Burmah, and China. The disease was communicated from Bombay *viâ* the Persian Gulf in 1820–21, and travelled northward, but did not extend into Europe.

During the year 1826 cholera again broke out over Bengal, and, passing through the Punjaub, it entered Cabul in 1828, and from thence extended to Persia, and so to Russia during the years 1829–30, and over the whole of Europe and the greater part of America.

In 1840–41 cholera accompanied a British force despatched from Calcutta to China; it broke out among our troops on their voyage to that country, and, having spread throughout the Chinese and Burmese empires, it passed in 1843–44 through Kashgar to Bokhara, and so to Cabul. From Afghanistan the disease extended south into Scinde, and westward in 1845–46 through Persia to Russia and Europe, reaching America in 1848.

In 1849 cholera was very fatal over Bengal; and during the season of 1851–52 it was communicated through the Punjaub and Bombay respectively to Persia and Arabia; and in 1853–54 it spread *viâ* Russia and Egypt with frightful virulence throughout Europe and America.

During the years 1860–61–62 cholera prevailed to an alarming extent throughout Bengal and the Central Provinces, and in 1864–65 in Bombay and along the shores of the Red Sea; thence it passed with pilgrims from Mecca to Egypt, and so to Europe, and for the fourth time to America. It is well to fix our attention on the lessons to be learnt from a careful study of the history of these early epidemics of Asiatic cholera; because, subsequently to 1865, the rapid and complicated means of transit between India and Europe has rendered it difficult, if not impossible, to trace the spread of the disease westward through the Red Sea route.

These outbursts of epidemic cholera were remarkably sudden in their advent, a considerable number of people in the affected locality being attacked by the disease within a few days after it appeared among them. The malady almost invariably died out from among the inhabitants of a country under its influence during the cold seasons of the year, to re-appear on the approach of summer. As a general rule, the disease was most deadly during the first year of the epidemic; it decreased in violence the second season, and then gradually disappeared, seldom prevailing in any one locality for more than three consecutive years.

Ætiology.—The more we study the early history of Asiatic cholera, the better shall we understand, that every outburst of the disease which occurred beyond the confines of India might invariably be traced back through a series of cases to that country. The disease has never broken out spontaneously in any part of the world—no amount of filth, of bad food, or climatic influences has up to the present time induced a widespread epidemic of cholera: it has invariably spread from its endemic area over the world. The inhabitants of countries far removed from Hindustan, and having limited communication with that empire, such as Australia, have not experienced the disease; whereas states in proportion as they are brought into intimate relation with India become subject to outbreaks of cholera.

Many of the earliest Anglo-Indian authors declared their conviction that the disease was contagious; others disputed this idea; but all agreed that cholera, when extending over a country, often settled on the inhabitants of low-lying, ill-drained, and overcrowded localities, and that it frequently left unharmed people residing beyond the affected area, although they might have been employed in attending patients suffering from the disease. It remained for Dr. Snow, in 1854, to explain this apparent mystery, and to demonstrate, as he did by means of the Broad Street case,[1] that the poison which causes cholera is contained in the excrements of those suffering from the disease, and 'that if by leakage, soakage from cesspools or drains, or through reckless casting out of slops and wash-water, any taint, however small, of the infective material gets access to wells, and other sources of drinking-water, it imparts to enormous volumes of water the power of propagating the disease' (Simon). Cholera patients cannot, in fact, communicate the affection to others, unless by means of the discharges which they pass. Persons attending them run no risk of contracting the disease, provided they are protected from swallowing the organic matter passed by the sick; but in badly ventilated rooms, this material, having been disseminated through the atmosphere, may be taken into the system by attendants and so poison them.

Sir William Aitken observes that the evidence in favour of the communicability of cholera by means of water or food, contaminated with cholera dejecta, has since 1854 become almost overwhelming. A remarkable instance of the kind, reported by the late Mr. Netten Radcliffe, took place in East London during the year 1866; and previous to this time, the circumstances of a case came under the writer's notice, in which a small quantity of a fresh rice-water stool, passed by a patient suffering from cholera, was accidentally mixed with some four or five gallons of water, and the mixture exposed to the rays of the tropical sun for twelve hours. Early the following morning nineteen people each swallowed about an ounce of this contaminated water—they only partook of it once—but within thirty-six hours five of these nineteen persons were seized with cholera. In this instance the choleraic evacuation did not touch the soil: as it was passed, so was it swallowed; but (and this is most important to remember) it had been largely diluted with impure water, and the mixture had been exposed to the light and heat of a tropical sun for twelve hours.

Professor Pettenkofer holds, that if the excreta from patients suffering from cholera pass into the earth, they may there, under peculiar conditions of the soil, moisture, and heat, undergo changes, and, having risen as a miasma into the air, be absorbed, and act as a poison on persons predisposed to the disease. It appears certain that cholera germs cannot multiply unless exposed to a definite range of temperature; they also require moisture, containing certain chemical substances, for their development and growth. The evidence brought together by Professor R. Koch and G. Gaffky in their admirable report on cholera in Egypt, and in India, in 1883, published in Berlin 1887, is sufficient to convince the writer that the germs of Asiatic cholera consist of a specific bacillus. This micro-organism is found in the contents of the intestinal canal, and in the matter passed by persons suffering from cholera. We know that if such excreta gain access through water or food to the intestinal canal of persons predisposed to cholera, they may become affected with the disease, and so we conclude that the symptoms characteristic of Asiatic cholera are in some way dependent on the action of the cholera bacillus. From the researches of Dr. Cartwright Wood, Professor Hueppe, and other authorities, we learn that infectious organisms are capable of splitting up the particles of living albumen at the temperature of the body, and that these dissociated elements may combine to form specific basic poisons: organisms, constituting a definite species, produce the poison of cholera, and exist at all times in the soil throughout the endemic area of the disease; but in this, its saprophytic form, the microbe has but feeble action on living albumen; it may, however, under certain conditions of the soil, temperature, and so on, become exceedingly vigorous, in fact, parasitic, and then it can break up living albuminoid elements into combinations possessing toxic properties. We may thus form some idea as to the relation that exists between endemic and epidemic Asiatic cholera, and account for the manner in which the disease develops in certain localities, and from thence spreads at times over the world along the lines of human intercourse. As Dr. C. Wood remarks, it is possible that, as in the case of Pasteur's vaccines, the cholera microbe, when in its saprophytic form, may protect human beings subject to its influence from the more deadly action of the same organism when it has burst forth into parasitic growth, and if such be the case, may we not hope to discover means whereby human beings can be preserved from the effects of Asiatic cholera? Drs. Pye-Smith and Lauder Brunton, from experiments made with choleraic discharges, are inclined to think that the outpouring of fluid from the glands of the intestinal canal in this disease, is due to paralysis of the mesenteric nerves in connexion with ganglia derived from the solar plexus. It may be that the poison produced by the cholera bacillus has some such effect; but it is a long step from the fact that microbes are capable of producing certain toxic compounds to the proof that Asiatic cholera depends on the influence of this poison on the mesenteric nerves.

Predisposing Causes.—As far back as 1869, in a work published by the writer on Asiatic cholera, the following observations occur (p. 420):—'With the exception of the specific cholera-infecting matter, I entirely ignore all other causes, or combination of causes, as capable of producing this disease. The circumstances under which people live may predispose them to the action of the organism; but neither air, water, nor any other agency can induce an attack of cholera, though many of them may serve as media by which the infecting matter is conveyed into the intestines.' P. 383 and p. 402:—'From researches I have instituted into this matter, there is reason to believe that the acids of a healthy stomach destroy the organic molecular matter in decomposing choleraic dejecta, so that when swallowed in a concentrated form they may be so acted on by the gastric juice as to have their infecting power destroyed; but when swallowed diluted with water, a portion of the fluid probably passes at once through the stomach, and reaching the alkaline contents of the small intestines, begins its work of destruction upon the epithelium.' 'Persons in bad health, whether suffering from actual disease, or in the less-defined ill-health which results from imperfect hygienic conditions, are those most apt to be attacked by cholera. This is the case with the poor of our large towns, which are generally situated on alluvial soil. May not this be due to the want of a healthy acid secretion from the walls of the stomach, which their more vigorous neighbours are blessed with?' Recent investigations have added little beyond this to our knowledge of the predisposing causes of Asiatic cholera.

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[1] By this discovery, the result of rigid scientific investigation, Dr. Snow rendered an immense service to mankind which has not been recognised as fully as it should be.—Editor.

Anatomical Characters.—The external appearances of the bodies of those who have died of cholera include the mottled skin, shrunken and livid appearance of the limbs, and other features hereafter described as characteristic of the disease during the stage of collapse. The temperature of the body rises after death, and it remains warm for some time. Rigor mortis sets in speedily, and is sometimes accompanied with muscular contractions, which displace the limbs of the corpse.

After death in the stage of collapse from Asiatic cholera, the only alteration to be discovered in the tissues and the blood is to be accounted for by the rapid drain of water into the intestinal canal which has occurred during life. The mucous surface of the stomach and small intestines is injected and swollen, and its epithelium is shed during life, and drops off from the mucous membrane in large patches within an hour and a half after death. Dr. Koch states that the cholera bacillus in many cases is found between the epithelium and the basement membrane, and also within the tubular glands; 'it also settles in large numbers on the surface of the villi of the intestines, and often had penetrated into their tissue, and in some instances had passed as far as the muscular layers of the intestine.' The epithelial cells lining the kidney-tubules, bladder, and other organs are found detached from the basement membrane, but they, like the blood, do not contain the cholera bacillus.

Abnormalities of a specific nature, especially with reference to the amount of blood contained in the right side of the heart and lungs, have been described by pathologists as being characteristic of Asiatic cholera; and in many instances after death from this disease, if the *post-mortem* examination is delayed for a few hours, the right side of the heart will be found full of blood, together with the pulmonary artery and its divisions, while the lungs are collapsed and bloodless. But there are numerous exceptions to this state of the heart and lungs, and the condition above described is not infrequently due to *post-mortem* changes; for if the bodies of those who have died of cholera be examined immediately after death, the left side of the heart will often be found as full of viscid blood as the right side. A peculiar shrunken condition of the lungs exists, depending on the dry and empty state of the bronchi, which allows the elasticity of the organs to drive the air out of them more completely than usual after the chest is opened.[1] On the other hand, when death has occurred during reaction, the smaller tubes are often found full of pus, and parts of the lungs may be œdematous, or even in a state of broncho-pneumonia (Fagge, *The Principles and Practice of Medicine*, p. 287).

Symptoms.—Asiatic cholera is most deadly at the commencement of an epidemic, and then usually begins without premonitory symptoms. The patient feels well up to within a few hours of the attack, or, it may be, goes to bed and sleeps soundly through the night, and immediately on rising in the morning is seized with violent purging and vomiting. After the first outburst of the disease, as a rule, cholera commences with diarrhœa, the stools being copious and watery, followed by great prostration of strength, with a peculiar feeling of exhaustion at the pit of the stomach; the sick person suffers from nausea, but seldom from actual vomiting or pain at the outset of the attack. If judiciously treated, many patients recover from this, the *first stage* of cholera; but if neglected the tendency of the disease is to grow rapidly worse. The stools become very frequent, and resemble in appearance and consistency the water in which rice has been boiled. These liquid evacuations flow away from the sick person with a sense of relief rather than otherwise. But the patient now commences to vomit, first throwing up the contents of his stomach, and subsequently all the water he drinks, mixed with mucus and disintegrated epithelium.

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[1] On this subject see the chapter on Epidemic Cholera in Dr. George Johnson's *Medical Lectures and Essays*.—Editor.

The fluid is rejected from his mouth with considerable force, and this adds to the increasing prostration which is one of the most urgent and marked features of the disease. The patient complains of intense thirst, and a burning heat at the pit of his stomach; he suffers also excruciating pain from cramps in the muscles of the extremities; he is terribly restless; and his urgent cry is for water to quench his thirst, and that some one might rub his limbs, and thus relieve the muscular spasm. Although the temperature of the sick person's body falls below the normal standard, he complains of feeling hot, and throws off the bed-clothes in order that he may keep himself cool. The pulse is rapid and very weak; the respirations are hurried; and the patient's voice becomes husky. His countenance is pinched, and the integument of his body feels inelastic and doughy, while the skin of his hands and feet becomes wrinkled and purplish in colour. The duration of this, the *second stage* of cholera, is very uncertain. It may last for two or three hours only, or may continue for twelve or fifteen hours; but so long as the pulse can be felt at the wrist, there are still good hopes of the sick person's recovery. The weaker the pulse becomes, the nearer the patient is to the *third*, or *collapse-stage* of cholera, from which probably not more than thirty-five per cent. recover. The result, however, depends much on the condition of the patient's heart. It is quite possible, although the cases must be rare, that a sudden outpouring of fluid into the intestinal canal has been sufficient to cause syncope and death in persons suffering from weak heart, before the liquid contents of the bowels have had time to be ejected through the mouth or anus.

In the third stage of the disease the vomiting and purging continue, although in a mitigated form; and the skin is covered with clammy perspiration, especially if the cramps are still severe. We now cease to be able to feel the pulse at the wrist, the lividity of the extremities and surface of the body increases, the patient cannot speak above a low whisper, his breathing is very rapid, his eyeballs are deeply sunk in their sockets, and his features are marvellously changed within a few hours. The urine is suppressed. The temperature of his body may fall as low as 94° F. The patient remains terribly restless, longing only for sleep, and that he may be supplied with water. His intellect is clear, but he seldom expresses any anxiety regarding worldly affairs, although fully conscious of the dangerous condition he is in; sleep, and a plentiful supply of drinking-water, are the sole desires of a person passing through the collapse-stage of cholera. This condition seldom lasts for more than twenty-four hours, and reaction either commences within that period, or the patient dies in collapse, or he passes on into the *tepid stage*, which in ninety-nine cases out of a hundred ends speedily in death. In the tepid stage of the disease the sick person's body feels cold to the touch, but the temperature, as shown by the thermometer, begins to rise rapidly, sometimes marking 99° or 100° F. The purging and vomiting cease; and the patient lies in a semi-comatose state, his eyes half-open, the ocular conjunctiva being deeply congested, the cornea hazy, and the pupils fixed. The pulse can be felt at the wrist, but the respirations are very hurried, suppression of urine continues, the patient's body is bathed in a cold clammy perspiration, the skin becomes of a dusky red hue, and death too frequently closes the scene within a few hours.

On the other hand, the sick person having been in the collapse-stage of cholera some twenty-four hours (it may be a longer or shorter period), the temperature of his body may begin to rise, gradually creeping up to the normal standard; the respirations diminish in frequency; the pulse returns; the patient can sleep, and after some thirty-six hours may pass a little urine: in fact, the functions of animal life are slowly restored, and the sick person recovers his health. This desirable result, however, is not infrequently thwarted by various complications which arise during the stage of reaction. Of these complications the following are the most important: suppression of urine; gastritis and enteritis; pulmonary congestion; meningitis; sloughing of the cornea; abscesses over the body; the formation of coagula in the right side of the heart or pulmonary arteries; hæmorrhage from the bowels; and roseola choleraica.

Diagnosis.—The question of the diagnosis of Asiatic cholera is discussed in the article on Choleraic Diarrhœa.

Prognosis.—The means of forming a prognosis in cholera may best be gathered from the preceding account of the disease. Speaking generally, the prognosis depends largely upon the stage of the disease, and upon the period in the epidemic at which the case occurs—that is, according as the patient has been seized at the outbreak, at the height, or towards the end of an epidemic.

Treatment.—In the first stage of Asiatic cholera we should endeavour to stop the purging, and without doubt opium is the drug upon which we may with the greatest confidence rely for effecting this purpose. When practising in the endemic area of cholera, the writer was in the habit of carrying about pills containing one grain of opium and four of acetate of lead, so that, if called to see a patient suffering from the disease in its early stage, no time was lost in administering one of these pills suspended in water. The next thing done was to make a large mustard poultice, and apply it over the whole surface of the patient's abdomen. The sick person was ordered to remain in bed, and to be allowed nothing in the shape of food or water; but he might suck as much ice as he felt inclined for.

If the patient was again purged after the first pill, a second was given, and a third (but not more) after each loose motion. It often happened that the first or second pill, together with the mustard poultice, ice, and rest, sufficed to check the progress of the disease, and the patient recovered. Supposing this treatment not to succeed, or that on first seeing the patient it be found that he has passed into the second stage of the disease, we should still prescribe the pill, as above directed, suspending it in water, because in the solid form it might be rejected entire, and under any circumstances it would take time to be dissolved by the fluid contained in the stomach; the mustard poultice also should be applied, and the sick person kept warm and in bed. Ice is invaluable in this stage of the disease, and unless a person has passed through an attack of cholera, it is impossible to realise the immense relief it affords. It should be given in small lumps, the sick person eating and swallowing as much as he chooses. He will frequently devour a pound or two of ice in the course of an hour, and he cannot take too much of it. In the treatment of cholera there can be no question as to the value of ice. The patient should be prohibited from drinking water or any other fluid beyond that which he gets from the ice. The practitioner must be firm on this point, turning a deaf ear to the entreaties of the sick man or his friends that he may be permitted to swallow even a small quantity of water; for if they once break through this rule, it will be impossible to limit the amount of liquid the patient may consume. If this treatment does not check the progress of the malady, we may prescribe three grains of acetate of lead and fifteen drops of diluted acetic acid in water every second hour, and fifteen drops of diluted sulphuric acid in water every alternate hour, so that the patient should take a draught, first of one mixture, then of the other, every hour. Five drops of spirit of camphor may be added to each dose of the medicine, but this drug requires care in its administration, and should seldom be continued beyond five or six doses of from five to ten drops each. Should the vomiting be very severe, in spite of the free administration of ice, a second mustard poultice should be applied over the abdomen; all medicine must then be omitted for an hour and a half, after which time a scruple of calomel may be sprinkled on the patient's tongue, and he should be made to wash it down with a little iced water. The cramps are best relieved by hand-friction, and if very severe, ease may from time to time be given by allowing the patient to inhale some ether. Hot-water bottles should be applied to the soles of the patient's feet, and also to his legs and abdomen.

Should the disease have reached the collapse-stage there is but little we can do for the patient. Ice must still be given, and, if the purging is frequent, the sulphuric acid draught (but no opium) may be administered every hour; heat and friction may with advantage be applied to the surface of the body; and the patient may now be permitted to drink iced water in moderation, provided it does not increase the vomiting. Wine and stimulants, if given by the mouth, do harm in this stage of cholera; but, if the purging has abated, enemata of warm beef-tea and brandy may be administered by the rectum every third hour. When reaction comes on, we must guard against doing too much—it is very rare indeed to see a patient in this condition sink from exhaustion, but probably many lives are lost by endeavours erroneously made, under the idea of keeping up the patient's strength. Iced milk or arrowroot is all that should be allowed to be given by the mouth for some time after reaction has set in; but enemata such as those above-mentioned, administered per rectum every five or six hours, or nutrient suppositories, are often beneficial, especially if the stomach remains irritable. Under these circumstances we not infrequently find that a small quantity of solid food is digested, when soup and liquids are rejected. In each case, however, the dictates of common sense and experience must guide the medical practitioner in his treatment of the sick person through the convalescent stage of the disease.

With reference to the treatment of suppression of urine after cholera, we should get the patient to drink about half a pint of water every second hour, so as to add fluid to his blood. Dry-cupping over the loins should be employed; and ten drops of the tincture of cantharides in water administered every hour, until a drachm of the drug has been given. It need hardly be remarked that suppression of urine after cholera is a most dangerous complication, and there is very little that can be done to restore the suspended functions of the kidneys.

PREVENTIVE TREATMENT.—Among persons predisposed to its influence, the infecting organisms of Asiatic cholera will manifest their effects on the system within five days of having been swallowed, but the germs of the disease do not always engender symptoms of virulent cholera. Nevertheless, in milder cases of the disease the evacuations passed by the patient may contain the microbes of cholera, and may therefore, under favourable conditions for its development, produce a deadly type of the malady. Consequently, the following remarks are applicable to instances of so-called *cholerine*, as well as to the severer forms of cholera. If the disease has appeared within a neighbourhood, a searching examination must be made into the condition and source of the local water-supply, not overlooking that of the milk, which is too often diluted with water before being sold. All surface and doubtful wells or reservoirs (especially those in the proximity of drains and cesspools) should be immediately closed; and it is desirable that the drinking-water, before being consumed, should be carefully boiled and filtered. All accumulations of house refuse and filth must be removed; and dirty places, both within and without uncleanly premises must be freely disinfected and cleansed. There is no necessity when the disease is prevalent for making any alteration in the usual diet; but in times of cholera we cannot too strongly insist on at once checking any tendency to diarrhœa, especially if it be of a watery nature. Many cases of incipient cholera have been prevented from running on into dangerous disease, by the early administration of pills containing four grains of acetate of lead and one of opium, one pill to be taken after each loose motion, to the extent of three pills.

If called to treat a case of Asiatic cholera, care should be taken that the rice-water stools, and the matters vomited, are disinfected by means of a solution of mercury perchloride or some other germicide, which should be poured over the bottom of the vessel into which the evacuations are received from the patient; and directly the dejecta are passed from the sick person, a solution of one part of carbolic acid to twenty of water should be sprinkled over them, and they must be immediately taken from the patient's room, and disposed of as follows:—If the sewage of the locality is conveyed away by means of a constant water-supply, the disinfected cholera evacuation should be thrown at once into the sewer. Drains used for a purpose of this kind must, however, be constantly flushed with a mixture containing about an ounce of ferrous sulphate to a pint of water. But if the drainage of the place passes into a cesspool, the disinfected cholera stools should be buried in a deep hole in the ground, removed from wells, and. if possible, from human habitations. It is a most dangerous practice, however carefully cholera stools have been disinfected, to allow them access to a cesspool. The room in which the patient has been treated must be freely disinfected, and his bedding subsequently burnt. If the sick person should die, the corpse is at once to be placed in a coffin containing a mixture of lime, charcoal, and carbolic acid: in fact, the body should immediately be buried in a mixture of this kind, and the coffin with its contents committed to the grave, or, better, consumed by fire within twenty-four hours of the patient's death.

By far the most important preventive measures to be adopted against cholera are to provide a pure supply of drinking-water, good drainage, ventilation, and cleanliness; for these means, if rightly enforced, must prevent the cholera germ from spreading among human beings.

The Vienna Cholera Conference has decided that quarantine is inapplicable to the circumstances of cholera; but this subject, together with the duties incumbent on sanitary and port authorities with reference to the preventive treatment of the disease, hardly falls within the scope of this article. *See* QUARANTINE. C. N. MACNAMARA.

CHOLERAIC DIARRHŒA. — SYNON.: Cholerine; Sporadic Cholera; Fr. *Choléra sporadique*; Ger. *Sporadische Cholera.*

DEFINITION.—An acute catarrhal affection of the mucous membrane of the stomach and small intestines, attended with vomiting and diarrhœa. The stools consist of a serous fluid, containing a little albumen. The whole system is implicated to a greater or less extent, through the rapid loss of water from the body, and its imperfect absorption through the intestinal canal during the active stages of the disease.

ÆTIOLOGY.—As remarked in the preceding article, it is only of late years that the question has arisen as to whether Asiatic cholera and simple cholera are identical diseases; but it seems probable that any obscurity which may exist on the subject occurs from the impression that similar symptoms are necessarily produced by precisely the same causes. It appears reasonable, however, to believe that, if the infecting matter of Asiatic cholera, when introduced into the intestinal canal, induces changes such as we have described, decomposing animal or vegetable substances, under certain conditions, may excite analogous changes in the mucous membrane of the alimentary canal, the consequence being that in both diseases a drain of serous fluid takes place from the bowels, followed by symptoms of cholera. In the case of Asiatic cholera, however, we believe that the discharges have the power, under favouring conditions, of propagating the disease, whereas the evacuations in simple cholera are in this respect less pernicious. Doubtless climatic and meteorological influences materially affect the susceptibility of the human subject to disease, and consequently we find that simple cholera, like the malignant form of the malady, is apt to prevail as an epidemic in moist or wet seasons of the year, and especially among people whose bodies are predisposed to pass into a diseased condition, from their having habitually breathed impure air and consumed unwholesome food and water, or become debilitated from other causes.

In a hot and moist climate like that of

Lower Bengal, choleraic diarrhœa is an affection which we meet with at all seasons of the year, and it is especially prevalent among infants who are being reared on cow's milk, or on other kinds of food prone to undergo putrefaction. Among the fish-eating Hindoos we frequently see several members of the same family who have been seized with symptoms of choleraic diarrhœa, attributable to the patients having partaken of fish which was slightly tainted. In fact, there are few more certain sources of this form of diarrhœa than stale fish; and it is evident that, whatever the deleterious influence may be which food of this description contains, the mere fact of keeping it in boiling water for some time does not destroy its poisonous properties.

It occasionally happens that cases of choleraic diarrhœa occur among people residing in malarious districts, the diarrhœa taking the place of the cold stage of a fit of ague; patients in these circumstances may be seized with all the symptoms of severe cholera, but they almost invariably recover from the attack.

Symptoms. — Choleraic diarrhœa begins suddenly; that is, the patient, whether an infant or an adult, has probably up to the commencement of the attack been in good health; there are, in fact, seldom any premonitory symptoms. A *child* may perhaps look somewhat paler than usual, and has a dark ring under his eyes, but beyond this appears to be perfectly well. Shortly after taking food, the infant vomits up a quantity of uncoagulated milk, the evacuation not being curdled like that from an overloaded stomach, the gastric secretion no longer having the power of coagulating the casein of milk. Soon after vomiting, or it may be before, the child commences to pass from the bowels an acid greenish-yellow fluid, containing flakes and often lumps of undigested food. The patient becomes very thirsty, is restless, and evidently in considerable pain, crying and drawing his legs up towards the abdomen. If these symptoms continue, the evacuations become colourless, resembling in appearance the rice-water stools of Asiatic cholera. The temperature of the body falls, the face becomes of a dusky hue, the features are pinched, and the eyeballs deeply sunk in their sockets. The fontanelles are depressed; the child is evidently terribly prostrated, his pulse can no longer be felt at the wrist, and his crying passes into a weak whimpering; he eagerly drinks water when offered him; and, as the exhaustion increases, convulsions supervene, and the child dies within a few days or even hours. On the other hand, the symptoms may abate at any stage of the disease, and the little patient gradually recover his health.

In the *adult* the symptoms of choleraic diarrhœa are much the same as those above detailed. There are seldom any premonitory symptoms, and the attack begins with nausea and vomiting, together with a sensation of exhaustion referable to the pit of the stomach; the vomiting is speedily followed, or it may be preceded, by purging; copious watery discharges are thus passed out of the body, and the larger and more rapid the evacuations the more they come to resemble the serum of the blood, which, in fact, drains into the intestinal canal and passes away from the stomach and bowels. The patient naturally complains under the circumstances of intense thirst. He is very restless; and at the commencement of the attack suffers from colicky pains in the abdomen, and subsequently from spasms and cramps, which often seize the muscles of the extremities. The pulse becomes small and weak, the respirations are hurried, the voice feeble, and the countenance pale and shrunken. The urine is scanty or suppressed; and the temperature of the body falls one or two degrees below the normal standard. These symptoms, as a rule, gradually subside, the purging and vomiting cease, and the patient falls off to sleep, waking more or less exhausted in proportion to the severity of the attack, but he usually recovers his health rapidly.

Diagnosis.—The question naturally arises, Are there any symptoms by which we can distinguish a case of choleraic diarrhœa from one of Asiatic cholera? In reply it may be affirmed that there is no characteristic symptom by which these affections can be diagnosed from one another. But, taking all the circumstances of any particular case into consideration, it is difficult, except on paper, to confound the two diseases; for unless a patient has recently imbibed the poison which produces Asiatic cholera, he cannot be suffering from that malady. Should the sick person reside in a neighbourhood affected by Asiatic cholera, we must, in forming an opinion as to the nature of the affection, be guided by the previous history of the case, the nature of the food consumed, and so on, and above all by the severity of the symptoms. Choleraic diarrhœa, even in the tropics, rarely passes on into collapse within a few hours from the commencement of the attack, such as is commonly seen in cases of Asiatic cholera; and, in the early stages of the former disease, there is seldom that complete loss of voice and pulse so characteristic of the malignant form of this affection. An experienced medical practitioner, placed at the bedside of a person suffering from Asiatic cholera, even in its earliest stages, feels no doubt whatever as to the nature of the affection, and is at once impressed with the grave responsibility of the charge which rests upon him: his anxiety is infinitely less when he meets with an instance of choleraic diarrhœa, although he is unable to lay down any hard and fast rules, by means of which he could define the difference that exists between the symptoms present and those occurring in a case of Asiatic cholera.

PROGNOSIS.—Although choleraic diarrhœa in its more severe forms resembles mild cases of Asiatic cholera, it is a comparatively harmless disease. Unless among young infants, or old and sickly people with weak hearts, no matter how threatening the symptoms may be, however great the collapse and depression of the patient may seem, a previously healthy adult seldom dies of choleraic diarrhœa.

TREATMENT.—In cases of simple cholera occurring in the child, the important point we must enforce in our treatment is that the affected part shall have rest. In practice, however, it is often difficult to persuade parents and nurses that an infant can exist uninjured for ten or fourteen hours on iced water; nevertheless, we must insist on a plan of this kind being carried out. The little patient will eagerly swallow cold water, either from a bottle or spoon, and the child may be allowed to take as much cold water as he requires, and to suck ice, which may be wrapped up in the corner of a handkerchief and put into his mouth. A poultice made of equal parts of mustard and flour, applied over the abdomen, is often very useful in this form of disease. With reference to drugs, should the treatment above indicated not relieve the symptoms, or should the vomiting be very constant, from two to four grains of calomel may be given, and repeated if necessary in an hour's time; however, if the diarrhœa is the more prominent symptom, calomel is not required, but a teaspoonful of castor oil should be administered. After the bowels have been cleared out, if the serous discharge continues, we should order astringents, in the form of $\frac{1}{8}$ of a grain of acetate of lead every hour, or $\frac{1}{16}$ of a grain of nitrate of silver, until the purging subsides. Tannic acid, in combination with diluted sulphuric acid and sugar, is frequently a useful combination to administer to children in cases of this description. With reference to opium, much as we dislike prescribing it for infants, it may be necessary in cases of simple cholera; but it should hardly be given in a mixture to be administered from time to time by a nurse. Opium under these circumstances can only be admissible when given by the medical attendant himself, in doses of one, two, or three minims of laudanum in a little weak brandy and water, carefully watching its effects. If the drug causes the child to sleep for a few hours, it may act almost like a charm: the infant awakes comparatively well. But if the opium has no such effect, we may be tempted to repeat the dose, but can scarcely give it a third time, at any rate until some hours have elapsed since the administration of the second dose. The symptoms having subsided, the child's diet must be strictly attended to, a good healthy wet nurse as a rule being an urgent necessity in the case of infants. Lime-water may with advantage be mixed with the child's food. The diet must be most carefully ordered. *See* DIARRHŒA.

With reference to the treatment of adults suffering from choleraic diarrhœa, we must bear in mind that, unless among old and debilitated persons, the patient will, as a rule, recover without medicine. If therefore called to prescribe for a case of this complaint, we may order fifteen minims of laudanum, or a drachm of the compound tincture of camphor in water, to be taken (supposing the patient is very sick) immediately after vomiting; half the above dose may be given at the expiration of one hour; and again after another hour, unless the symptoms have in the meantime subsided. A large mustard poultice should be applied over the abdomen, and the patient must be confined to bed, and kept on ice and iced water; he should not, however, be permitted to swallow too much liquid. If the vomiting is severe, a scruple of calomel may be given to an adult, or in the first instance an effervescing mixture with hydrocyanic acid may be employed to allay the sickness. On the other hand, should the diarrhœa be excessive, we may with advantage prescribe four grains of acetate of lead and ten drops of diluted acetic acid every second hour; or pills containing a drop of creasote, a quarter of a grain of nitrate of silver, a grain of camphor, and two grains of Dover's powder, to be repeated after each loose motion.

Among old or weakly persons, and also in the case of infants, it is often necessary to administer brandy and water from time to time, according to the state of the patient's pulse.

C. N. MACNAMARA.

CHOLERINE.—A term applied to a class of cases which occur during the prevalence of cholera, in which the milder symptoms of the disease are present. It has also been used to designate the poison on which cholera is supposed to depend. *See* CHOLERA, ASIATIC; and CHOLERAIC DIARRHŒA.

CHOLESTEATOMA (χολή, bile; and *στεάτωμα* [Galen], a fatty tumour).—An encysted tumour, consisting chiefly of cholesterin. *See* CYSTS.

CHOLESTERIN (χολή, bile; and στεῤῥός, solid. The term *cholestearin*, occasionally used, is derived from χολή, bile; and στέαρ, suet).—SYNON.: Fr. *Cholestérine*; Ger. *Cholesterin*; *Gallenfett*.

CHEMICAL AND PHYSICAL PROPERTIES.—Cholesterin is a monatomic alcohol, represented by the empirical formula $C_{26}H_{44}O$, first discovered, in 1755, by Conradi in ox-bile, its exact composition being subsequently ascertained by Chevreul. It is probable that there are several isomeric substances included within the term, though one only is known to occur in the human body. When pure it occurs as white, tasteless, inodorous, glittering scales, which form needles when crystallised out from solution in chloroform, and as rhombic plates, often deficient at one corner, when derived from alcoholic and ethereal solutions (*see* MICROSCOPE IN MEDICINE). It is insoluble in water, alkalis, and dilute acids, but readily dissolves in ether, chloroform, boiling alcohol, benzol, turpentine, and solutions of the bile-acids, and its solutions are lævo-rotatory. It melts at 145° F. The crystals heated with strong sulphuric acid give a carmine-red colour, or with strong nitric acid a yellow colour; with the former acid and tincture of iodine a violet which becomes blue-green.

SOURCES.—The exact physiological significance of cholesterin is not known, but it is generally regarded as a product of the metabolism of the nervous tissues, which should be eliminated by the liver in the bile. It is a normal constituent of certain of the tissues, forming nearly 50 per cent. of the solids of the white nervous matter, and 18½ per cent. of the solids of the grey matter, being probably combined therein with true fatty substances; it is estimated to form ·25 per cent. of the red corpuscles of the blood; ·4 per cent. of human bile; and it occurs in minute quantities in the spleen, urine, milk, and serum, and as a constant though quantitatively variable ingredient of the fæces, where it has been erroneously supposed to be represented by stercorin, which substance is in reality an impure form of cholesterin (*see* FÆCES, Examination of). It is also found in the yolk of egg. A cholesterin is of widespread occurrence among plants (such as peas and maize, also in almond and olive oils), and may be regarded as a decomposition-product of some of the albuminous constituents of the cells.

PATHOLOGICAL RELATIONS.—The pathological occurrence of cholesterin is varied and of unknown import. It is liable to be much increased in quantity in the normal places of its occurrence; thus in association with jaundice, though apparently not always, the blood has been known to contain 4 or 5 per cent.; in the bile it may be so abundant as to form crystals or be deposited as gall-stones, of which it forms the greater portion; in the fæces, when they are free from bile, a considerable increase of cholesterin and fats may be met with. In exceptional cases of renal disease crystals have been deposited in the urine. The fluid of cysts, especially hydatid and ovarian, seems to be more liable to contain cholesterin than effusions into serous cavities; and this fact has been considered of some value in the diagnosis of ascites from ovarian dropsy. But it sometimes occurs in considerable quantities in hydrocele fluids, and it has been met with in old pleural and peritoneal effusions, where it appears as glistening particles suspended in the fluid. In the caseous degeneration of pus and other inflammatory products crystals of this substance are sometimes formed, and in this way may be found in sputum and other excreta.

The train of nervous and other symptoms which often accompanies long-continued jaundice has been attributed to the retention of cholesterin in the blood, and hence the term *cholesteræmia* was employed to denote this condition. It is certain, however, that cholesterin as such is quite inert and harmless to the tissues, and it is undesirable to perpetuate the expression. *See* CHOLÆMIA.

W. H. ALLCHIN.

CHORDEE (χορδή, a harpstring).—DEFINITION.—Painful imperfect erection of the penis during gonorrhœa.

ÆTIOLOGY AND PATHOLOGY.—Chordee is most common in the second and third weeks of gonorrhœa, and rarely attacks the patient after the third week. In exceptional cases, on the contrary, chordee, absent in the acute stage, is violently developed after the inflammation has become chronic and very slight. The bulbous part of the urethra is generally intensely inflamed when chordee happens; and, further, chordee is very uncommon when the urethritis is limited to the anterior or posterior portions of the canal.

The *mechanism* of chordee is imperfectly understood. Two explanations have been put forward:—(*a*) That the corpus spongiosum surrounding the urethra being affected by inflammation through the effusion of lymph into its substance, proper distension of its spongy tissue and elongation during erection cannot take place. Hence it is drawn tight like a bowstring by the arching of the distended corpora cavernosa. (*b*) That the inflammatory condition of the mucous membrane and submucous tissue at the bulbous part excites reflex spasm of the muscles surrounding that part of the corpus spongiosum. This prevents distension of the parts compressed; while the corpora cavernosa, being untrammelled, continue to expand in the ordinary manner. The first explanation is insufficient to account for some cases where the inflammatory action is very slight, and there is no evidence that lymph has been effused into the erectile tissue; for example, after a plastic operation on the penis. Again, natural erection has been known to take place very shortly after the subsidence of gonorrhœal inflammation, and, it is fair to suppose, before effused lymph can have been absorbed. The second explanation is unsatisfactory, because spasm of other muscles of the perinæum is often absent. In our present imperfect knowledge of the purposes served by the nervi erigentes, these theories must be accepted with reserve. Probably both methods may be active in producing chordee.

The causes of chordee are *indirect* or *direct*. The most common indirect cause is urethritis or urethral congestion. Direct causes are the reflex irritants which usually produce erection during sleep, such as stimulating food and drink, strongly acid urine, great superficial warmth of the body, or a distended bladder.

Symptoms.—The organ grows suddenly turgid and assumes a bowed or crooked form, causing acute pain, which is felt at the part and towards the perinæum. In severe cases the strain causes rupture of the mucous membrane and spongy tissue, with hæmorrhage. The loss of blood is usually limited to a few drops, and gives relief to the pain. Rarely the hæmorrhage is rapid and prolonged.

Treatment.—Abstinence from stimulants of all kinds, and late suppers; light clothing, and a hard mattress at night, are the best means of preventing chordee. Micturition at short intervals during the night must be enjoined. Of medicines the best is a suppository, at bed-time, of one grain of crude opium in ten grains of cacao-butter. The subcutaneous injection into the perinæum of one-sixth grain of acetate of morphine is also an effectual remedy. Both these applications should be followed by an aperient saline draught the next morning. A drachm of spirit of camphor thrown just before it is swallowed into an ounce of water, and taken on lying down at night, is also useful, and it may be repeated once if chordee awaken the patient; but it is a very uncertain remedy. More trustworthy are twenty or twenty-five grains of chloral hydrate in syrup and water at bed-time, and repeated in four or six hours if needed. Bathing the genitals and perinæum with very hot water for ten minutes before going to bed sometimes proves successful. The application of a spiral coil of narrow india-rubber tubing round the penis and scrotum, through which a continuous current of ice-cold water flows, is also an excellent preventive.

To subdue an attack of chordee the best measures are voiding urine; the application of cold to the perinæum, by sitting on a cold seat, or applying an evaporating lotion or ice; and the upright posture.

Berkeley Hill.

CHOREA (χορεία, a dance).—Synon.: Chorea Minor; St. Vitus's Dance; Fr. *Danse de St.-Guy*; *Chorée*; Ger. *Veitstanz.*

Definition.—A disease of the nervous system, characterised by a succession of irregular, clonic, involuntary movements of limited range, occurring in almost all parts of the body.

The distinctive features of the movements are the entire absence of either rhythm or method in their recurrence; that not individual muscles but co-ordinate groups are affected; and not one or more groups only, but almost all the muscles in turn. There is not actual loss of command over the muscles, but voluntary movements are interfered with by superaddition of involuntary movements. As a rule the movements cease during sleep.

Ætiology.—Chorea is a disease of childhood: it is most common between the ages of eight and twelve, very rare before six, and rare after sixteen. It is more than twice as frequent in girls as in boys, especially after the age of nine. It occurs more frequently in families in which nervous diseases are hereditary than in others. It is more common in large towns than in the country; and far more frequent among the poor than among those in comfortable circumstances. Want of proper food, neglect, ill-usage, with the weakness and anæmia induced by these means, are very common antecedents, or chorea may follow measles or other febrile disease of childhood. Children well-nourished and with a good colour, exposed to none of these causes, may however suffer. An intimate association between chorea and rheumatism has long been recognised. A large proportion of the children suffering from chorea are found to have had acute or subacute rheumatism, and some of the most terrible cases met with, especially after the age of puberty, are those in which the chorea comes on during or just after acute rheumatism. Whether traceable to rheumatism or not, there is very frequently found in chorea a cardiac murmur, usually mitral systolic, sometimes aortic. This may or may not disappear after recovery. In almost all the fatal cases of chorea which have been examined after death, endocarditis with fibrinous vegetations on the valves has been present. In adults, pregnancy divides with rheumatism the causation of this affection; recovery generally speedily follows delivery, and can rarely be brought about till this has taken place. Bad habits, and disorders of menstruation, are also undoubtedly capable of inducing chorea. Intestinal worms again have appeared to set up the disease, and instances are on record in which the expulsion of worms has been followed at once by cessation of the movements, but this must be extremely rare. Fright or some powerful emotion is very frequently assigned as the cause; and it is seldom that parents are not prepared with the instance required. But, making allowance for this, and notwithstanding the fact that endocarditis may be present in cases said to have originated in fright, it does not seem possible to exclude fright as a cause of chorea. The influence of imitation is less certain. The disease is said to be far less common in negroes.

Anatomical Characters and Pathology. The study of chorea, as of epilepsy and many other affections of the nervous system, has been hampered by its being regarded as a morbid unity. The view here maintained is that it is a symptom rather than a disease, and that the characteristic movements are in relation not with the *nature* of the morbid change, but with its *seat*. The seat of the disturbance is the corpus striatum, its character probably different in different cases; but the anatomical condition cannot amount to actual breach of structure, since that is known to give rise to hemiplegia, while it must obviously be of a kind to impair the functional vigour of the ganglia. Chorea has been called 'insanity of the muscles'; a better phrase (as the writer has said elsewhere) would be 'delirium of the sensori-motor ganglia.' In delirium there is loss of control over the mental processes, with rapid succession of incoherent and imperfect ideas; in chorea loss of control over the motor apparatus, with movements excessive in point of number and extent, but wanting in vigour and precision.

In some cases of chorea nothing abnormal has been detected after death, but usually the minute methods of investigation now pursued yield positive results. The largest series of examinations published is contained in a communication to the Royal Medical and Chirurgical Society, in the session of 1875–6, by Dr. Dickinson. He describes dilatations of the minute arteries as existing throughout the brain and cord, more especially, however, in the corpus striatum and optic thalamus, with small hæmorrhages; and considers the disease to be due to a widely spread hyperæmia of the nerve-centres. He did not find capillary embolisms, but does not appear to have drawn out the arterioles to look for them. The appearances he describes are very much those producible by impaction of microscopic particles of fibrin in the minute vessels. Capillary embolisms have been found by Dr. Tuckwell and other observers, predominantly in the central ganglia, but also in the central convolutions and spinal cord, accompanied by patches of softening and minute hæmorrhages. In almost all fatal cases of chorea there is endocarditis with deposits of beads of lymph on the mitral or aortic valves, or both, whether a murmur have been audible during life or not.

The *post-mortem* appearances consequently do not indicate any localisation of the morbid change in the central ganglia. But it is to be remembered that the fatal cases are those in which there is not only extreme violence in the choreic movements, but usually also delirium and other symptoms. There are in fact multiple symptoms just as there are multiple lesions, and we are called upon to distribute the symptoms, and assign them to their respective sources, by such knowledge of the functions of the different nerve-centres as physiology affords us. The delirium or comparative dementia is thus attributed to the lesions in the convolutions; the loss of speech to lesions in convolutions or in lower centres, according to its character; the impairment of sensation to lesions in the thalami; the chorea to lesions in the corpora striata. The grounds upon which this last localisation—that in which we are immediately concerned—is decided, are as follows. We exclude the cerebral hemispheres and cerebellum, rather arbitrarily perhaps, since there is much to be said in favour of their contributing to excite the movement, now especially that convolutional motor areas have been demonstrated by Hitzig and Ferrier. The important point to be made clear, however, is that chorea has not its seat in the cord. The arguments and evidences against this are: (1) that *tonic* and not *clonic* spasm is characteristic of persistent spinal irritation; (2) the degree of control over the movements retained by the will; (3) their increase under emotion; (4) their cessation during sleep. To those, which were originally advanced by Dr. Russell Reynolds, may be added: (5) the diminished reflex action on tickling; and (6) the phenomena of hemichorea and its relations with hemiplegia. The evidence afforded by hemichorea is so conclusive that other considerations have been merely alluded to. It cannot be supposed, for example, that one lateral half of the entire length of pons, medulla, and cord can be affected without implication of the other half, which would be the case with hemichorea of spinal origin; and still more conclusive is the fact that when in hemichorea there is impairment of sensation it is on the same side with the movements, and not, as in hemiparaplegia (due to the division of one half of the cord), on the opposite side to the motor paralysis. The parallelism between hemichorea and hemiplegia is so perfect as to suggest at once that the two affections represent different conditions of the same nerve-centres, and is made more complete by the very discrepancies, as they may at first sight appear, which have been considered to be objections. In hemiplegia there are certain muscles which more or less completely escape paralysis: the motores oculorum, orbiculares palpebrarum, and other facial muscles, the muscles of the neck, chest, back, and abdomen. In hemichorea the irregular movements cross the median line and invade the opposite side in these same muscles, This has been explained (rightly or wrongly) by the hypothesis that all these muscles acting in compulsory concert with the corresponding (or other) muscles of the opposite side, the nerve-nuclei of the bilaterally associated muscles will be commissurally associated in the cord, so as to become in effect a single nucleus, and this single nucleus for muscles on each side of the body, being connected with both corpora striata, is thrown into action by the sound corpus striatum when its fellow of the opposite side is damaged, as in hemiplegia, thus preventing paralysis; and, on the other hand, is reached by the irregular impulses from the corpus striatum affected in hemichorea, thus causing bilateral chorea in the parts enumerated.

In addition to the correspondence between hemichorea and hemiplegia just described, there are transitions from one to the other, and combinations of the two to be mentioned below, under the head of Complications. Hemiplegia may be succeeded by hemichorea (the *post-hemiplegic chorea* of various observers); or chorea may deepen into paralysis; or, as in a case reported by the writer, there may be with chorea of the limbs on one side, first chorea, then paralysis (hemiplegiform), and then again chorea of the same side of the face. The conclusion is obvious, that hemiplegia and hemichorea in these cases are indicative of different degrees of damage in the same centre. Hemichorea and hemianæsthesia have been found very constantly associated with structural lesions in the white fibres just outside the posterior extremity of the thalamus, usually involving also the ganglion itself at this part.

The well-known embolic theory of chorea originated by Kirkes, and improved and ably maintained by Dr. Hughlings Jackson, at once finds its place here. Capillary embolism is of all others the condition which might be expected to induce the instability without abolition of function which exists in chorea, and in almost all cases a fertile source of fibrinous shreds is present, in the form of vegetations on the valves of the heart; the fact of embolism, again, has repeatedly been demonstrated. While, however, giving to capillary embolism a prominent place among the causes of chorea, it cannot be considered as the only cause. The clinical differences between ordinary chorea and the acute and fatal form are of themselves suggestive of a different pathology; and the speedy recovery after delivery in the chorea of pregnancy, or (as in one or two cases on record) after expulsion of intestinal worms, is inconsistent with the existence of embolism. What the precise anatomical condition is can only be matter of conjecture, but it will be some form of innutrition; irritability and debility, as the late Dr. C. B. Radcliffe has abundantly demonstrated, going together. Hyperæmia, with capillary blood-stasis, and capillary thrombosis by cohering leucocytes, have been suggested as causes. Prolonged arterial spasm from persistent reflex irritation, uterine or intestinal, or the more brief contraction of the cerebral vessels from fright, may perhaps lower the functional vigour of the ganglia to the degree required. Dr. Octavius Sturges has ably maintained the view that chorea is a purely functional affection, and that the movements are adequately accounted for by instability of nerve-cells without any structural or vascular change recognisable even by the microscope, comparing it in this respect with epilepsy. A very important consideration is the remarkable limitation of chorea to the period of childhood—the period between infancy and puberty. This is a limitation, if not without parallel, certainly unequalled, and it points to a condition of nerve-centres in childhood which specially favours the occurrence of the disease. This condition may be said with confidence to be the fact that childhood is the period of special activity of the sensori-motor ganglia.

SYMPTOMS.—In a slight case of chorea the patient, usually a child, may be perfectly quiet when lying down, and for a short time even when sitting or standing, if not conscious of being under observation; but when walking, or while under examination, there will be various fidgety actions—abrupt flexion of the fingers, a sudden pronation of the forearm, or hitching up of one shoulder, or twist of the body, or there is shuffling of a foot on the floor, or, again, a jerk of the head or twitch of the mouth or eyes. If the patient be told to do anything, the movements will be multiplied and exaggerated in the muscles employed. A small object will be picked up and held, but the hand is brought down upon it hastily and after various irregular excursions. In a more severe case the grimaces, contortions, and jerkings succeed each other without intermission. The gait is now very peculiar, being slow, shuffling, and uneven; the steps of irregular length and unequal time; and the line of progress deviating. In the worst forms of this disease every muscle appears to be thrown in turn into violent contraction, the face is distorted this way and that, the eyes roll to and fro, the teeth are snapped or ground together, the whole body writhes, and the limbs are in unceasing motion. It is to be remarked that, even in extreme cases, the movements, violent as they may be, are in some degree circumscribed; the arms, for example, are not thrown up over the head, nor do the legs go to the full extent of their range of motion; the tongue is rarely bitten, though the lips may be. Deglutition is greatly interfered with in a severe attack, and the evacuations may be discharged involuntarily. In the mildest forms the diaphragm and muscles of the chest and abdomen are affected, causing irregularity in respiration. The action of the heart may also be irregular, but this is probably secondary to the respiratory variations in frequency and depth, and is not attributable to chorea of the heart. There is generally impairment of motor power, and frequently diminution of sensation. This is most readily ascertained in hemichorea, that is, chorea affecting one half of the body only, when the sound side can be employed for comparison; but in the violent forms of the disease, when the skin is gradually worn through by incessant friction, there is often so little complaint of pain that sensibility must, it would seem, be blunted. Reflex sensibility is also commonly dull.

It has already been stated that the movements cease during sleep; this is a rule to which exceptions are rare though not unknown, even in mild cases, and especially in hemichorea.

Chorea is usually gradual in access, even in the cases which ultimately become severe; it is very commonly one-sided for a time, and occasionally throughout, when the name hemichorea is given. It is not, however, strictly unilateral in these cases, as the movements transgress the median line and affect the corresponding muscles of both sides of the body at those parts where these are bilaterally associated, and where in hemiplegia there is immunity from the paralysis, as, for instance, the oculo-motor muscles, and the muscles of the neck, chest, and abdomen.

Complications.—The foregoing description applies more or less to all cases of chorea, but there are often additional symptoms, and it will conduce to clearness if these are considered apart and called complications. Mention has been made of impairment of motor power; at times this amounts to complete paralysis, and the relations and combinations of chorea and paralysis, and especially of hemichorea and hemiplegia, throw much light on the disease. Paralytic chorea has been described as a special variety of the affection, but no line of demarcation exists between this and the common form. Chorea sometimes succeeds hemiplegia in the paralysed parts; more rarely chorea deepens into paralysis. Cases again occur in which with facial hemiplegia there is chorea of the limbs of the same side. Speech is very commonly more or less affected and occasionally completely lost for a time. The difficulty is usually articulatory, chorea of the muscles of respiration, phonation, and articulation interfering with utterance of words; but there is in some cases true aphasia, and when this is so, there is the same tendency to the association of aphasia with right hemichorea as with right hemiplegia. The intellect may suffer; the face has often an idiotic expression, usually from the muscular contortion or atony, but sometimes indicative of temporary imbecility. In the violent and fatal forms there is almost always delirium. Impairment of sensation is common, and hemianæsthesia is almost always associated with hemichorea. For Heart Complications, *see* Ætiology.

Duration, Terminations, and Prognosis.—The average duration of chorea is about two months; if prolonged beyond three months it may be exceedingly chronic and go on better and worse for one or two years. There is a tendency to spontaneous recovery; but on the other hand relapses are common. Chorea is rarely fatal in children; when it is so the case is usually acute and violent from a very early period of the attack, and it is rare for a case to run the usual course for a time, and then take on a very severe character. After puberty, and especially when it supervenes on acute rheumatism, it is very dangerous, but less so when associated with menstrual disorders and pregnancy than in youths or men.

Diagnosis.—It is only necessary under this head to warn against the mistake of confounding with the movements of chorea the tremor or jactitation of disseminated sclerosis of the nerve-centres, which, though most common in adults, is not unknown in childhood.

Treatment.—In a large proportion of cases of chorea, especially such as come into the hospitals of London, rest and food, with perhaps aperients, are all that are required for recovery. But it can scarcely be denied that medicinal treatment often renders important services, especially in cases of a lingering character. The causation and pathological condition being various, it is to be expected that the remedies required will be different, and the attempt should be made to adapt the treatment to the special features of the case, the basis of all being the endeavour to improve the nutrition of the body generally, and of the nervous system, by good food, rest, and warmth. The food may be supplemented by cod-liver oil, and the late Dr. C. B. Radcliffe attached importance to the free administration of wine or other stimulants. Any recognised cause should be removed, such as constipation or worms; irregularities or suspension of the catamenia should receive attention; when there is pregnancy it may perhaps be necessary to induce premature labour. When the chorea is accompanied by rheumatoid pains and feverishness, iodide of potassium with ammonia may have a remarkably good effect. Iron in some form or other is very generally useful, but especially when the patient is anæmic. Another remedy is sulphate of zinc, given in doses gradually increasing from one or two grains three times a day, to six, eight, or ten grains, till sickness is induced, when in some cases the disease appears to be cut short. The remedy which in the writer's experience has been found most generally useful is arsenic. Trousseau sometimes gave strychnine in gradually increasing doses till its physiological effects manifested themselves. On the other hand, conium, recommended by Dr. John Harley, has been extensively employed; the only trustworthy preparation is the Juice, which should be given in gradually increasing doses, beginning with a drachm and going up to one or two ounces if necessary, till its depressing effect on the muscles becomes evident. It has not, in the writer's hands, given satisfactory results. The same may be said of the application of ether-spray along the spine, which has been strongly recommended, except in acute cases in which the freezing of the skin here has in some cases been followed at once by sleep, and in a few days by alleviation of the violence of the chorea. Baths, warm and cold, especially shower-baths, spinal douches, spinal ice-bags, gymnastics, musical gymnastics, that is, movements timed by music, have advocates, and may no doubt be useful in suitable cases.

In the terrible cases of acute chorea the great indications are to procure rest for the poor sufferer and keep up the strength. Milk, eggs, beef-tea, and other forms of concentrated fluid nourishment, should be given freely, together with wine or brandy. Conium, hyoscyamus, bromide of potassium or ammonium, and chloral hydrate, have been tried separately or in combination, with more or less appearance of success; chloroform, again, may be administered; chloral hydrate by the mouth or rectum, and hypodermic injection of morphine, with free administration of brandy, have, in the writer's judgment, appeared to do much good. It is in these cases that tartar emetic in full doses has been recommended; it is certainly tolerated in an astonishing degree. Restraint of the violent movements is often a great comfort to the patient; the limbs should be carefully bandaged with flannel and bound, the legs together, the arms to the sides, a folded blanket, across the abdomen and hips, keeping down the body. If half-done it only adds to the suffering, but when properly carried out it gives a feeling of relief and favours sleep. W. H. BROADBENT.

CHOROIDITIS.—Inflammation of the choroid. *See* EYE AND ITS APPENDAGES, Diseases of.

CHROMIDROSIS (χρῶμα, colour; and ἰδρώς, sweat).—Coloured perspiration. *See* PERSPIRATION, Disorders of.

CHRONIC (χρόνος, time).—This word is applied to a disease when its progress is slow, and its duration prolonged. *See* DISEASE, Duration of.

CHYLOUS URINE.—*See* CHYLURIA.

CHYLURIA[1] (χυλός, chyle; and οὖρον, urine).—SYNON.: Galacturia; Chylous Urine; Fr. *Urine laiteuse*; Ger. *Chylurie*; *Milchsaftiger Harnabgang.*

The affection known as chylous or chyloid urine has long remained a puzzle to physicians, not only on account of the very remarkable character assumed by the secretion, but also on account of the very erratic course which the disease runs. Scarcely any two persons affected with this malady give a similar account of its mode of onset, of the duration of the attack, or of the symptoms and seasons of its occurrence. The writer has had the opportunity of studying from thirty to forty cases of the disease in Calcutta; and the variety of symptoms presented, and the numerous causes, of the most opposite character, to which the disease has been attributed, are very perplexing. The histories of the cases published by various observers present a like uncertainty, and Sir William Roberts very aptly describes the course which the disease runs as marked by an irregularity and capriciousness which baffle explanation. It would seem as though the one symptom which may be looked upon as constant is the condition of the urine implied by the designation which was applied to the disorder by Prout.

DEFINITION.—[A diseased condition, originating in the great majority of cases in tropical or sub-tropical climates, which manifests itself usually by a more or less milky appearance of the urine, modified at times by an admixture of a variable proportion of a substance resembling blood.]

On standing, the fluid coagulates, so as to present the appearance of size. A microscopic nematoid entozoon (*Filaria sanguinis hominis nocturna*) is generally found in the blood and urine of persons affected with the disease.

[GEOGRAPHICAL DISTRIBUTION. — This is peculiar. The vast majority of cases are tropical or sub-tropical in their origin. Nevertheless, from time to time, cases crop up in the persons of individuals who have never been out of the temperate zones, nor in any way exposed to tropical influences.[1] Moreover, the disease is not equally distributed over the zone in which, in a general way, it may be said to be endemic. In most tropical countries it is of more or less frequent occurrence, but there are districts in these same countries which enjoy an immunity similar to that of temperate climates. The explanation of this apparent caprice in the distribution of chyluria is afforded by the peculiarity of the distribution of the *filaria sanguinis hominis nocturna*—its principal ætiological factor.]

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[1] It has been deemed advisable, in view of recent advances in our knowledge of chyluria and allied subjects, to slightly alter and rearrange the late Dr. Lewis's articles. These advances are, in a great measure, the outcome of Dr. Lewis's own discoveries, and it is, therefore, much to be regretted that his premature death has deprived the Editor of his assistance. Those portions of the article on CHYLURIA which are placed within brackets are new; the unbracketed parts are as they stood originally, and nearly as they were written by Dr. Lewis.

[1] Of the four or five cases which have been recorded as having originally occurred in Europe, one is furnished by Sir William Roberts, the patient never having been out of Lancashire; and another by Dr. Beale, in a person who had never resided out of Norfolk.

SYMPTOMS.—So far as is at present known, there are no premonitory symptoms of chyluria. Sometimes the only symptom is the milky condition of the urine—a condition which usually comes on very suddenly; generally, however, the patient complains of an uneasiness, scarcely amounting to pain, across the loins, along the ureters, over the bladder, or along the course of the urethra—especially towards the perinæum in the male. There is generally marked debility, with mental depression. Occasionally chylo-serous discharges take place from various parts of the body—the axilla, the surface of the abdomen, the groin, and especially from the scrotum, in that condition of it which is known as elephantiasis lymphangiectodes (Bristowe), nævoid elephantiasis, or varix lymphaticus. The disease is also sometimes observed associated with true elephantiasis of the limbs and scrotum. It occurs at all ages, from childhood to extreme old age, and in about equal proportion among the sexes—perhaps more frequently in the female than in the male.

With regard to the *urine*, it presents, as already mentioned, a milky appearance, and frequently emits a strong milky or whey-like odour, which is made more evident by warmth. After standing a short time the fluid coagulates, so as to form a more or less semi-solid mass resembling blancmange. In the course of a few hours the clot contracts, and the urine becomes rapidly decomposed. In some cases the fluid presents a pink colour, from the admixture of [coloured corpuscles like those of] blood. Commonly—at least, in India—the blood-like admixture, when present, is seen forming a shreddy adherent coagulum at the bottom of the vessel after it has stood for some hours. Not infrequently the flow of urine is suddenly stopped during micturition by the blocking up temporarily of the urethra with one of the clots. The specific gravity varies greatly—may range in the same individual from 1007 to over 1020. Shaken up with ether, the urine loses its milky aspect; and when nitric acid or heat is applied, a precipitate almost invariably results. These characters, and the fact of the coagulability of the fluid, indicate the presence of fat, albumen, and fibrin, all of which are to be considered as abnormal constituents. The proportion, however, in which they exist in different individuals, and even in the same individual at different times, varies greatly. Dr. Beale's analyses show, that though a specimen of urine may contain at one time 1·39 per cent. of fat, another specimen, obtained a few hours later, from the same person, may contain none. In the majority of cases the fatty element is usually scanty in the morning before meals, and so are the other abnormal elements, unless exercise have been taken, or the circulation otherwise accelerated. Under the latter circumstance, as the late Dr. Bence-Jones has shown, the albumen is increased, without, however, a corresponding increase of the fat.[1] It is evident, therefore, that in order to institute a comparison between the character of the urine and the character of the various nutritive fluids, for the purpose of ascertaining from which of them the abnormal constituents of the urine are derived, the results of analyses of the latter fluids at different times of the day and at different stages of the disease should be taken. Further, as the nutritive fluids themselves undergo constant changes dependent on the quality of the nourishment supplied and the time which has elapsed since partaking of it, it is equally evident that any single analysis would be insufficient. An attempt has been made to bring together in the following table all of what appeared to be the most trustworthy analyses of these fluids which have been published. In order to simplify the table, only the estimates of the albuminoid and fatty matters have been given, these being the most pronounced of the more readily estimated abnormal constituents in the urine:—

Constituents selected.	URINE in chyluria. [Mean of 15 analyses.]	BLOOD in chyluria. [Hoppe-Seyler.]	BLOOD—Normal human. [Becquerel and Rodier.]	CHYLE [Mean of 6 analyses: man, cow, horse, ass, dog, cat.]	LYMPH—human [Mean of 4 analyses].
Albuminoids	0·54%	3·35%	7·00%	7·08%	2·96%
Fatty matters	0·80%	0·67%	0·06%	0·92%	0·56%

A glance at this table illustrates the fact that the relative proportion of the albuminoids to the fatty matter in chylous urine does not correspond with the proportion in which they are found in any one of the nutritive fluids of the body. In normal blood, for example, the fatty matter is as 1 to 116 of the albuminoid, whereas in the urine the former exceeds the latter to a very considerable extent. The same discrepancy, but to a less degree, is found to exist when the urine and chyle are compared—the quantity of albumen in the latter being more than seven times greater than that of fat. The proportion of these substances in lymph approaches more closely to what is encountered in the urine—the fat being to the albumen as 1 to 4 very nearly. The specimen of chyluria-blood analysed by Hoppe-Seyler[2] approaches very closely to the average composition of human lymph—the fatty matters being as 1 to 5 of the albuminoid, thus differing in this respect very considerably from Dr. Bence-Jones' analyses of similar blood, where the quantity of fat given is that of normal blood. On the other hand, the urine of the man from whom this blood was obtained yielded a proportion of fat almost identical with what Hoppe-Seyler obtained in the urine of the person whose blood he examined—the figures given by the former writer being 0·74 and by the latter 0·72 per cent. The composition of the blood in this affection must be regarded as hitherto unsettled. Guibort found in a clot of it almost twice, and Hoppe-Seyler about eleven times, as much fat as is found in normal blood; on the other hand, Rayer, Bence-Jones, and Crevaux could detect no change in its composition. It is possible that the discrepancy in the results of these analyses and macroscopic examinations of the blood may be due in part to the particular moment when the blood was abstracted. According to M. Claude Bernard, 'Les urines chyleuses ressemblent au sang d'un animal en digestion, ou plutot à celui des oies que l'engraisse.'[1]

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[1] *Phil. Trans. of Royal Soc.*, cxl., 1850, p. 651.

[2] *Med.-chem. Untersuchungen*, 1871, s. 551–56. Abstract by Dr. Ferrier in *Journ. Chem. Soc.*, vol. ix., 1871; p. 740.

Microscopical Characters of the Urine.—[The filaria sanguinis hominis may generally be detected in the urine.] In making a search for it, it is advisable to pick out one of the coagulated shreds found in the urine, transfer it to the glass slide by means of a forceps or pipette, and carefully tease the fragment before applying the cover-glass.

[A still better plan is to break up the coagulum in the urine with a glass rod as soon as it is formed, and then to search the sediment which, after an hour or two, collects at the bottom of the vessel in the same way as is customary in examining for 'casts.' As large a slide as is practicable ought to be examined, and a low power employed in the first instance, as it often happens that the filariæ are present, but only in very small numbers, and might be readily overlooked if a small quantity of sediment is examined or a high power employed.]

[The periodicity characteristic of the filaria when in the blood is not observed by the parasite in the urine. It may be found in chylous urine passed during the day as well as in that passed during the night. In a certain, though small proportion, of cases the parasite cannot be found; but there is every reason to suppose that at one time, even in these instances, the filaria had been present. Cases are on record in which, after its presence had been fully ascertained, the parasite disappeared from the urine while the patient was under observation, the chyluria persisting. In the rare instances of chyluria originating outside the endemic area the filaria will, of course, not be found at any time. It is difficult to define the limits of this area, however, so that in every case of chyluria the parasite ought to be sought for.]

The other leading microscopical character of the urine is the minutely molecular matter—fat in an emulsified condition—to which the fluid owes its opaline or milky aspect. There are also numerous white, lymphoid corpuscles, together with red corpuscles, numerous or the reverse according to the degree of sanguinolence of the urine. Casts of the tubular structure of the kidney—indicative of organic disease of these organs—are seldom to be seen; they were absent in all the cases that have come under the writer's observation.

With regard to the *microscopical examination of the blood*, the writer has not observed that the corpuscles or serum presented any abnormality indicative of the presence of fatty matter in any form—the serum has seemed as clear and as free from molecular matter as normal blood. As far as his experience goes, the only feature worthy of special note in connexion with microscopical examination of the blood in chyluria is the presence of the hæmatozoon already referred to. [In consequence of the periodicity observed by the filaria in the blood, it is absolutely necessary that this examination be made during the late evening, the night, or the early morning; some time between 9 P.M. and 6 A.M. is the best. Searched for at this time, and as recommended elsewhere (*see* FILARIA SANGUINIS HOMINIS), the filaria is usually found in the blood; if it is absent from the urine it will not be found in the blood. If it is found in the blood in chyluric cases it will also be found in the urine; but it sometimes happens that, though the filaria is present in the urine, yet the most careful and prolonged examination may fail to detect it in the blood.]

ANATOMICAL CHARACTERS.—The *post-mortem* examinations of persons who have died whilst affected with chyluria also testify to the freedom of the kidneys from disease. This was the case in two autopsies conducted by Dr. McConnell in Calcutta. The writer had the opportunity of examining the kidneys of the first case, and all the organs of the body of the other case, but could find nothing in any of the organs or tissues suggestive of being a cause of the urinary derangement, except the fact that all the vessels — arteries as well as veins — contained the filaria in their minutest ramifications.

[But, although no evidence of disease of the parenchyma of the kidneys has been discovered in connexion with this disease, two more recent and carefully conducted *post-mortem* examinations have shown that the lymphatic system connected with the urinary tract may be seriously deranged. This is only what might have been expected from the frequency with which chyluria is associated with diseased conditions of the lymphatics in different parts of the body—notably of the scrotum and the inguinal glands. Dr. Stephen Mackenzie[1] and Ponfick[2] have each put on record details of such examinations, and in both instances thickening and dilatation of the thoracic duct, and marked varicosity of the pelvic and other lymphatics were found. It can be readily understood—as pointed out by Sir William Roberts[3]—how a varicosity, which may have been distinct enough during life, would collapse after death, and be difficult then to demonstrate and readily overlooked; and it is possible that in this circumstance lies the explanation of the negative results of most of the *post-mortem* examinations of cases of chyluria.]

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[1] Quoted by Crevaux, *op. cit.*

ÆTIOLOGY AND PATHOLOGY.—Having considered in detail what seem to be the leading pathological features of chyluria, a brief reference may be made to the views which prevail regarding its ætiology. These may be comprised under three heads:—(1) Dr. Vandyke Carter[4] advocates the view that a direct communication exists between the chyle-carrying vessels and the urinary tracts. (2) MM. Claude Bernard and Ch. Robin believe that the condition of the urine is but a symptom of piarrhæmia—fatty blood; the latter condition being but the normal condition of the blood for some time after the partaking of food, aggravated and made permanent by derangement of the digestive organs—notably the liver. One of these distinguished authors (M. Robin) suggests, further, that this derangement is probably induced in the liver and elsewhere by the filaria sanguinis hominis.[5] (3) The third view to be noticed is that advanced by Sir William Roberts. This view appears to be based mainly on the history of a very remarkable case, published by him in 1868. It was one in which a coagulablo chylo-lymphous discharge escaped from open vesicles which had formed over the surface of the abdomen; the patient's urine was, moreover, chylous for two days. Sir William Roberts suggests that a condition somewhat similar to that on the surface of the abdomen existed in the urinary tract—a sort of eczema—probably on the front of the bladder. *Post-mortem* examination did not, however, confirm this view, nor could anything be detected in any of the organs suggestive of a cause, but this authority infers that this was probably due 'to the fact that in the last few weeks of life the morbid process had retrograded and had consequently left no appreciable marks on the surface of the bladder.' The examination of the skin in the diseased part showed that the *cutis vera* and the subcutaneous tissue were traversed by short channels or lacunæ from the width of a crow-quill to that of a hair. A careful study of this and other cases suggested to Sir William Roberts the view that one, at least, of the forms of chyluria may be due to hypertrophy of the lymphatic channels, and subsequent acquisition by them of gland properties. M. Robin's view does not suggest any special anatomical difficulty, but it remains to be demonstrated more conclusively than has hitherto been done that the blood in man ever contains a sufficient quantity of fatty matter to produce such extreme milkiness by admixture with the urine as is observed in chyluria. Sir William Roberts' theory is certainly not open to these particular objections, as, given a certain agent to start the formation of these glandular tissues, there does not appear to be any special anatomical or physiological difficulty to be got over; but the results of all the autopsies as yet recorded do not warrant the inference of the existence of such pathological conditions. Future observation, however, may show that they really do exist.

[Multiplied observations, made during recent years, have made it more than probable that Dr. Carter's view of the pathology of chyluria is the correct one—namely, that somewhere in the urinary tract there is a varicose condition of the lymphatics, similar to that found in elephantiasis lymphangiectodes, varix lymphaticus, or lymph-scrotum—a disease, as pointed out, also commonly associated with the filaria, and very frequently with chyluria. Either the mature parasite itself, or its young, or its prematurely expelled ova, or stenotic conditions of the lymphatic trunks induced by some of these, act as a mechanical obstruction to the onward flow of the lymph, and thus induce a varicose condition of the lymphatics on the distal side of the seat of the obstruction. Rupture of the varicose vessels will then admit the lymph to the urine if the varicosity is anywhere in the urinary tract.]

[For diagnostic purposes, as well as to arrive at a correct idea of the pathology of chyluria, it is necessary to bear in mind that whilst chylous urine, or its coagula, on the one hand, may be clear as the purest gelatine or, on the other hand, white like milk—in most cases from time to time, in others always—they may have a blood-like tinge, often of great intensity. This latter circumstance is likely to lead the unwary to a diagnosis of hæmaturia, and give rise to the idea that blood-vessels as well as lymph-vessels are in some way involved; all the more so as genuine hæmaturia is endemic and very prevalent in many of the countries—Egypt, for example—in which chyluria is also endemic (*see* ENTOZOA; *Bilharzia*). Some authors, misled by a false idea of the pathology of the disease, describe these cases of red chyluria under the name of hæmaturia, or hæmato-chyluria, assuming, and apparently being under the impression, that genuine blood from the blood-vessels is the cause of the red colour of the chylous clots in the urine. It is quite possible for the same individual to be the subject of chyluria and also of hæmaturia, and such a coincidence has been noted; but in an ordinary case of red-tinted chylous urine there is no reason to suppose, further than that suggested by the colour only of the urine, that the term chyluria, applied to these cases, is unscientific, or that the characteristic pathological feature is derived from any set of vessels other than the lymphatics. In the first place, it is very unlikely that both sets of vessels—blood-vessels and lymphatics—could be similarly affected in the same individual and in the same organ; and, in the second place, it is well known that the contents of the thoracic duct, and of some of the larger lymphatics, and also lymph long stagnant in obstructed lymphatics, acquire a red tinge from the normal advance of the development in them of red blood-corpuscles.[1] Hence, undoubtedly, the red colour so frequently seen in the coagula referred to. In the same way may be explained the absence, or gradations, of milkiness occasionally encountered. If the abnormal element in the urine be derived from vessels into which no chyle has regurgitated, if the vessels are filled with a chyle in which the fatty element is defective, either from peculiarities of diet or from its relation as regards time to the period of digestion, it will be less milky and more transparent and jelly-like. The differences in the analyses of chylous urines admit of a similar explanation.]

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[1] *Trans. Path. Soc.*, 1882, vol. xxxiii.
[2] *Berlin. klin. Wochen.* 4 Oct., 1880.
[3] *Urinary and Renal Diseases.*
[4] *Trans. Med. and Phys. Soc. Bombay*, vol. vii. 1861. *Medico-Chir. Trans.*, vol. xlv., 1862.
[5] *Leçons sur les Humeurs*, 2nd edit. 1874, p. 845.

Of the ætiological significance of the presence of the filaria in the circulation there can, the writer thinks, scarcely be much doubt—more especially when the number of observations recorded within the short period that has elapsed since attention has been drawn to its existence therein, is taken into consideration. These suggest more than a fortuitous connexion; indeed, it might rather be said that chylo-serous effusions may be considered as symptomatic of the parasitism. Filariæ have even been detected shortly *before* chyluria had manifested itself.

[As regards those cases of chyluria apparently unassociated with the filaria, we must bear in mind that anything which could give rise to constriction or blocking of the lymph-channels might act in the same way as the filaria does as regards producing lymphatic varicosity and rupture. Thus pressure by a tumour, constriction from inflammatory thickening in or about the walls of the thoracic duct or pelvic lymphatics, or stricture following ulceration of their walls, might, it is conceivable, bring about this state of varicosity leading to rupture and possibly to chyluria.]

Prognosis.—Persons have been known to suffer off and on from this affection for from one to fifty years. This would suggest that the malady usually runs a chronic course, which, as a rule, it doubtless does; on the other hand, patients apparently in fair health otherwise have been known to die very unexpectedly from no recognised acute disorder. With regard to the prospect of a cure a very guarded opinion should be given, as the probability is that the complaint will return again and again so long as life lasts—even when the disease commences at a very early age, and often after a complete change of climate and avocation.

Treatment.—This has proved extremely unsatisfactory in almost all the cases recorded; in fact it cannot be distinctly stated that the course of the disease has been materially modified, much less cured, by any known remedy. Iodide of potassium has been tried in large doses, and in some cases appears to have been beneficial; in others the tincture of the perchloride of iron has seemed to be more successful. A decoction of the bark of Rhizophora racemosa (mangrove) has a reputation in Guiana, just as a decoction of the seed of Nigella sativa (used also as a condiment in curries) has in India. The latter remedy has, however, been known to be powerless in mitigating the malady even in cases where on former occasions it had been resorted to with apparent success. Perhaps the most satisfactory results which have been published are those which have followed the administration of large doses of gallic acid—one or two drachms a day.

[Large doses of benzoic acid given in glycerine have, in some hands, been followed by a cessation for a time of the chyluria. But from what we now know about the pathology of this disease, it is evident that rest in the recumbent position, with elevation of the pelvis, is by far the most important indication to be attended to in the treatment.] *See* Filaria sanguinis hominis.

Timothy Lewis. Patrick Manson.

CICATRISATION (*cicatrix*, a scar). Cicatrisation is the process by which solutions of continuity in an organ or tissue are repaired. These solutions of continuity may be due to injury, ulceration, extravasation, or the effusion of inflammatory products. The result of the process is the formation of a cicatrix or scar.

Pathology.—Cicatrisation as it occurs in superficial parts in surgical practice may be selected as affording a typical illustration of the process. It is most frequently and easily observed, and it corresponds to what is met with in deeper tissues.

Repair may take place either with or without the occurrence of granulation, and the process of granulation may or may not be accompanied by suppuration; the existence both of granulation and of suppuration depending on the degrees of abnormal stimulation to which the injured tissues are subjected.

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[1] Gibson., *Journ. of Anat. and Physiol.*, vol. xx. 1886.

Healing by first intention.—In an incised wound favourably circumstanced as to vascularity of tissue, absence of tension, and apposition of edges, epidermic continuity may be re-established in thirty-six to seventy-two hours. The lips of such a wound are temporarily united by a thin layer of lymph and white corpuscles of the blood, and perhaps soon afterwards by cells proliferated from connective-tissue corpuscles. These cells become spindle-shaped, and are ultimately converted into ordinary connective-tissue corpuscles, whilst offsets from the neighbouring capillaries re-establish the circulation throughout the new tissue. Coincidently with these changes the surface becomes covered with epithelium. The resulting scar at first appears as a red line, which subsequently becomes white from the disappearance of many of its blood-vessels.

Healing by scabbing.—When an open wound heals by scabbing, the epidermis spreads over the tissues without the intervention of the process of granulation, owing to the protection afforded them by the crust of blood and lymph which has formed upon the wound.

Recent antiseptic surgery has shown that even large hollow wounds filled with blood-clot, such as are caused, say, by operation for ununited fracture of the femur, may cicatrise completely without suppuration or granulation, if protected from the stimulation of the antiseptic used. In these cases the white corpuscles of the clot become organised directly into fibro-plastic cells and connective-tissue corpuscles, and the new epidermis will probably be formed beneath a thin upper layer of the clot.

Healing by granulation.—If a recent wound, too large for scabbing, be simply left exposed to the air, or treated with water dressing, or with an ordinary antiseptic, there will be a discharge at first of serum tinged with blood, then of pale serum, and afterwards of cloudy yellowish serum, replaced in about three days by fully-formed pus. By this time the wound will be studded over with little bright red elevations, termed granulations, which ultimately cover the whole surface. Granulation-tissue consists of nucleated cells, amongst which pass vascular loops with thin walls. After an interval the edges of the skin are seen to be on a level with the granulating surface, and as it were continuous with it. Perhaps already the wound is much smaller, owing to the shrinking of the granulations as their cells assume the spindle-cell type. Then, extending from the cutaneous margin there may be observed a narrow red line, brighter than the rest of the granulating surface, owing to the presence of a layer of transparent epidermis. Next day this zone will be bluish, from the growing opacity of the epidermic cells, and there will be a fresh red line corresponding with the newest epithelium. A day later the outer layer will have become so opaque as to be whitish, and the second to be bluish; and there will again be a fresh inner red line, which will gradually advance until the scar is complete. The new epidermis quickly separates into a horny and a mucous layer. *See* also Skin Grafting.

The healing of an evacuated abscess-cavity depends partly upon the contraction, and partly upon the coalescence of the granulations of which its pyogenic membrane consists. This contraction is an essential part of the cicatrising process, and often causes deformities and secondary effects by pressure exerted on vessels and nerves.

Many cases of disease of joints (caries, &c.), and the behaviour of abscesses treated antiseptically and with adequate drainage, may be referred to as instances of the existence of non-suppurating granulations.

John Bishop. R. J. Godlee.

CINCHONISM.—A condition induced by the administration of quinine, the chief active principle of cinchona. *See* Quinism.

CINCLISIS (κιγκλίζω, I move often). This word signifies agitation or motion, and was formerly applied to involuntary winking or movements of the eyelids; and also to the movements of the chest in dyspnœa.

CIRCULATION, Disorders of.—Abnormal excess and deficiency of blood are known as *hyperæmia* and *anæmia* respectively. Each of these may be *general* or *local*. We also recognise as a disorder of circulation stagnation or *local cyanosis*.

I. Hyperæmia. — *General* hyperæmia signifies excess of blood in the body, and is also called *plethora*. *Local* hyperæmia means excess of blood in a part. Such excess may be caused either by superabundant supply, or by deficient removal of blood through the agency of the blood-vessels. Dilatation of the arteries, however produced, causes more copious afflux of blood, which fills the capillaries and veins in a corresponding degree, so that there is excess of blood in all the vessels of the part. This condition is called *arterial* or *active hyperæmia*, *active congestion*, or *determination of blood*. If, on the other hand, blood is imperfectly removed by the veins, these vessels, as well as the capillaries, become gorged, and the condition called *venous* or *passive hyperæmia*, or *venous congestion*, results. It is doubtful whether there can be *capillary hyperæmia*, except as the result of one of these conditions.

A. *Arterial or Active Hyperæmia.*—An excessive amount of blood can be conveyed by the arteries only under two conditions:—(1) Enlargement of these vessels by relaxation of their muscular walls; (2) Increased pressure within them, from obstruction of collateral channels with which they communicate, *i.e.* collateral hyperæmia.

(1) Relaxation of the muscular walls may be caused *directly* by violence or by warmth, as is illustrated in the redness of the skin produced by a blow, by heat, or by the reaction after intense cold. Sudden withdrawal of pressure has the same effect, as is sometimes seen on evacuating a hydrocele or fluid-collection in a serous cavity. Dry-cupping produces similar but more complex results, the veins being acted upon as much as the arteries. Relaxation of the muscle-fibres is produced also *indirectly* through the vaso-motor nerves. If these are paralysed, relaxation of the fibres occurs, and the arteries dilate. Experimental section of the cervical sympathetic in animals shows this most clearly; but the same result follows less constantly if other nerves containing vaso-motor fibres are divided or injured, such as the mixed nerves of the limbs, or branches of the trigeminus. Wounds of the brachial plexus have been found to cause hyperæmia of the fingers (*glossy fingers* of Paget). When the section is complete, hyperæmia is only transitory, and is soon followed by a return to the normal condition, or even by undue anæmia, which is permanent. In irritative lesions, on the other hand, such as gunshot wounds, hyperæmia continues as long as the irritation. In such cases it is possible that the lesion is not paralytic, but depends upon stimulation of the actively dilating vaso-motor fibres which physiologists have now shown to exist in many parts of the body, since stimulation of these produces the same result as paralysis of the inhibitory fibres. Hyperæmia often accompanies neuralgia, both depending upon some morbid condition of the nerve. The starting point of the neurosis in all these cases may be, and often is, in the central nervous system, and hence chronic diseases of the spinal cord or brain are often accompanied by general paralytic hyperæmia—that is, flushing, or by congestion of special parts. The same result may come from reflex nervous action, set up by disturbances of the digestive organs, the organs of generation, or of other parts.

(2) Collateral hyperæmia is a consequence of the rise of pressure produced by the blocking-up of arterial channels in the adjoining parts. It is usually effected by the enlargement of existing vessels, and the conversion of small, almost capillary, vessels into pulsating arteries. It occurs not only in the familiar instances of surgical ligature, and the sudden blocking of an artery by a plug (*see* EMBOLISM), but in the gradual obstruction which accompanies atrophic and sclerotic processes. When the chief afferent blood-channels to an organ become obstructed, its peripheral parts are very liable to become hyperæmic, a principle which when applied to such cases as cirrhosis of the liver, granular kidney, and sclerosis of the brain, will be found fruitful in practical deductions.

SIGNS AND RESULTS.—The colour of parts in a state of active hyperæmia is, during life, bright red, the arteries, large and small, being visibly injected, while the capillaries, filled with arterial blood, produce a diffuse red colour. In experimental hyperæmia the blood may remain bright red even in the veins. The temperature of external parts becomes elevated, though not above that of internal parts. Sometimes there is obvious pulsation or throbbing. There may be swelling, which is due to simple enlargement of the vessels, not to exudation of fluid, since this does not occur from arterial hyperæmia alone. The nerves, both those of common sensation and those of special sense, are more excitable than they are normally. There is usually a subjective sensation of warmth, and there may be pain or itching.

Arterial hyperæmia may last for a long time without producing any change whatever in the part affected, but may, under conditions little understood, give rise to hypertrophy, which sometimes, though rarely, results from section of the cervical sympathetic. Transitory but repeated hyperæmic conditions more regularly produce this result, as is seen in hypertrophy from pressure; in thickening of the skull from excessive exposure of the head to the sun; in hypertrophy of the skin of the face and its glands from frequently recurring hyperæmia (*acne rosacea*). This kind of hyperæmia constantly precedes inflammation, but can hardly be said to produce it. It does, however, render the tissues more vulnerable, bringing them into a condition in which a slight cause will set up inflammation. Unless the vessels are unsound, simple arterial hyperæmia does not lead to hæmorrhage.

B. *Passive Hyperæmia or Venous Congestion.*—This may be due to—(1) Feeble circulation; or (2) Obstruction in the veins.

(1) Blood may be imperfectly removed from a part, owing to the imperfect action of the forces which normally maintain the flow of blood in the veins. These are, besides the action of the heart, the pressure of muscles (combined with the arrangement of the valves in the veins), and the movement of the thorax in inspiration. If these are deficient, the venous current will be everywhere delayed, but notably in those parts where it has to overcome the action of gravity. In the erect posture this will be the case in the lower limbs; and hence venous congestion is common in the legs, ankles, and feet. In decumbent patients, for analogous reasons, the

nates, sacrum, shoulder-blades, and the bases of the lungs behind become the seat of what is called *hypostatic congestion.* Very general obstruction, such as results from imperfection of the heart itself, may lead to the condition called *cyanosis*, which is essentially venous congestion, and to similar congestion of the lungs, liver, kidneys, and other internal organs, with very serious results.

(2) Obstruction of the veins is rarely produced by a morbid condition of the walls of these vessels, but may result from coagulation of blood within them. Another cause is external pressure, such as that of tumours, of the gravid uterus, or of the intestinal contents, as in the case of the hæmorrhoidal veins. Finally, indurative changes in the solid viscera lead to venous obstruction, as is seen in cirrhosis of the liver, which produces congestion of the whole portal system.

SIGNS AND RESULTS.—The colour of parts in a state of passive hyperæmia is bluish rather than red, the veins, large and small, being injected with venous blood, and the capillaries, in which the blood is also venous, producing a uniform purple colour. If the congestion is extreme, collateral venous channels are likely to be established, which are sometimes the only evident sign of internal venous obstruction. The surface is usually cooler rather than hotter when compared with corresponding parts of the body; and there is no unusual nervous sensibility or sense of throbbing. Swelling very frequently occurs, and depends on actual serous effusion from the vessels, so that the parts are often anasarcous, pitting on pressure; while in cavities there is an accumulation of fluid.

Venous congestion produces more important and permanent results than arterial. In experimental venous obstruction, besides engorgement of the vessels, two nearly constant phenomena are seen—copious transudation of serum, and passage of a number of red blood-discs through the walls of the capillaries and smaller veins. Few or no white corpuscles emigrate, and the arterial circulation is unaltered. The absence or occurrence of dropsy depends upon the adequacy or inadequacy of the lymphatics to carry off the superfluous serum. In ordinary pathological venous congestion all these changes are seen to some extent; extravasation of red blood-discs being shown by the pigmentation of parts in chronic congestion, though this is not evident in the acute condition. Chronic venous congestion increases the hardness and density of organs, a change which may, in the first instance, result from simple œdema, but in the end is due to fibroid change (*see* DEGENERATION). Such organs are at first enlarged, but ultimately diminish in size, and suffer fatty atrophy, not only through the general law of fibroid change, but because venous blood is inadequate to the proper nutrition of tissues. These changes are seen in the liver and kidneys in cases of obstructive heart-disease. External parts, as the skin of the lower part of the leg, show by a tendency to ulceration that they are imperfectly nourished, and are also liable to become inflamed from slight causes (varicose eczema).

POST-MORTEM CHARACTERS.—The appearance of hyperæmic parts after death is not necessarily the same as during life. The colour of the blood does not enable us to say whether the hyperæmia was arterial or venous. All blood contained in the body after death, excluded from the air, is dark or venous, but becomes florid when exposed to the air, unless it have previously undergone some *post-mortem* change, or some morbid alteration during life. This change may be watched in the lungs when the chest is opened, especially in the case of children whose lungs have little local colour. The only important point after death is the fulness of the three kinds of vessels. Arteries are usually empty, unless diseased; the larger veins almost always full. If the smaller veins and arteries are conspicuously and brightly injected, the part may be described simply as congested; a uniform colour indicates fulness of the capillaries, which may be confirmed by the microscope. Uncomplicated arterial hyperæmia leaves no trace after death; the appearance of it is produced by inflammation. Simple venous hyperæmia can only be recognised as such after death—by comparison, that is, with the same part under normal conditions. Chronic venous congestion is indicated by many of the same characters as during life. Care should be taken not to mistake for arterial hyperæmia mere staining with blood-pigment of the walls of the vessels; nor for venous congestion mere *post-mortem* hypostasis, or the settling down of the blood, if fluid, after death.

II. **Anæmia.**—*General* anæmia is a morbid condition in which there is a deficiency of blood, or, more correctly, a deficiency of the red corpuscles of the blood, throughout the whole body. It is also called *oligæmia*, or *oligocythæmia* (*see* ANÆMIA). *Local* anæmia, with which we are here concerned, signifies deficiency of blood in a part. It may be complete or partial. Complete local anæmia can only occur when the blood-supply of a part is totally cut off by obstruction of its arteries. The conditions and consequences of such obstruction are discussed elsewhere (*see* EMBOLISM). Partial anæmia or *ischæmia* may be produced by direct pressure, or else by arterial obstruction, permanent or transitory. Permanent anæmia of many parts results from gradual obstruction of arteries by atheromatous change; or, still more strikingly, by a form of endarteritis (*endarteritis obliterans*) generally due to syphilis; or, again, from deposition of fibrin on the diseased vascular wall. Temporary anæmia results from spasmodic contraction of the annular fibre-cells in the muscular coat of the artery. Such a contraction may be produced experimentally by direct electrical stimulation, or by stimulation of the sympathetic branches distributed to the vessel; and in pathological conditions we find such contraction occurring in consequence of some derangement of the nerve-centres, or from reflex irritation, or even, as it would seem, idiopathically. Neuralgia and migraine are often accompanied or caused by spasm of the arteries, and epilepsy has, with less certainty, been attributed to the same cause. In these cases it is possible, as is held by some authorities, that anæmia of the nerve-tissue is the cause of the disturbed innervation. Hysterical blindness, and probably other hysterical affections, may be explained in the same way. Partial anæmia may, as shown elsewhere, lead to local cyanosis, with the appearance of venous hyperæmia. Total anæmia necessarily causes necrosis of the part; and even partial anæmia produces characteristic changes.

Signs and Results.—An anæmic part is pale, its temperature in the case of external parts is diminished, and there is weakened or arrested arterial pulsation. A permanent condition of partial anæmia produces degeneration, ending in atrophy of the affected part. The wasting of the skin, and possibly that of the kidneys in old age, is due to this cause. Transitory anæmia causes necessarily a cessation of functional activity in the part, as is obvious in the nerve-centres and the muscles; but does not, so far as we know, produce any permanent change. Compression or obstruction of the abdominal aorta produces symptoms of temporary paraplegia, from anæmia of the lower part of the spinal cord.

III. **Local Cyanosis.**—It must not be supposed that a venous condition of the blood in a part, with consequent purple colour, low temperature, and deficient vitality, is necessarily due to venous engorgement. It may be due, as is obvious in external parts, to mere stagnation in the capillaries. When blood is stagnant, or nearly so, it becomes venous, having given up its oxygen to the tissues; and the part shows the characters of venous congestion. This is seen in the familiar instance of the effects of external cold on the extremities. A similar condition, which may be called *local cyanosis*, sometimes occurs independently of, or only assisted by, the action of cold, in certain parts, such as the extremities of the fingers and toes, the tips of the ears and the nose. It is possible that similar conditions of internal parts may occur. A part affected with local cyanosis may undergo partial necrosis or inflammation, as in the case of frost-bite or chilblain.

Some persons, especially when young, have a constitutional proclivity to this condition, especially in cold weather, and have been described as having a 'chilblain circulation'; but it is not necessarily associated with chilblains, properly so-called. In other cases the cyanosis is preceded by, or alternates with, a condition of anæmia in the part, and is evidently due to a functional disturbance of circulation, more or less transient. In its extreme form, when occurring suddenly, and affecting deeper parts as well as the skin, and leading to necrosis, this constitutes Raynaud's disease. The condition is nearly always symmetrical, affecting corresponding parts on both sides of the body.

Ætiology.—The constitutional or habitual form of local cyanosis is generally associated with malnutrition and sluggish circulation; but it does not appear that mere weakness of the heart is sufficient to produce it, or is more than a contributory factor. The fault of circulation appears to lie in the arteries, and to consist either in habitual spasm, or possibly in want of tone. Imperfect nutrition of the walls of the capillaries may also, by retarding the flow, assist in producing stagnation. In the more transient forms there would seem to be spasm of the smaller arteries, causing anæmia, on which capillary stagnation supervenes. The slighter forms occur chiefly in women, accompanying hysteria or menstrual disturbances, or at the climacteric period. Such persons present an alternation of 'dead fingers' with cyanotic circulation. The severe form known as Raynaud's disease is attributable to more complete and sudden spasm of arteries, deep as well as superficial. In both these forms there must be some antecedent derangement of the vaso-motor nerves, dependent probably upon deeper-lying disturbances of the nervous system, probably central, which cannot here be discussed.

Consequences.—The slighter form may cause no material change, or may lead to the same series of changes as seen in chilblains, namely, necrosis of epidermis, with formation of imperfect bullæ, and inflammation, ending possibly in ulceration. It is difficult to draw the line between these changes and those produced in healthy persons by frost-bite. In Raynaud's disease complete necrosis, causing symmetrical gangrene of deeper parts, may result.

Treatment.—Young persons, with a tendency to local cyanosis, should be well fed, warmly clothed, and encouraged to take vigorous exercise for short periods. Cod-liver oil is the most useful drug; but iron or arsenic may also have their place. When the condition is paroxysmal, rather than constant, large doses of sulphate of quinine (5 gr. twice or thrice daily) are sometimes extremely useful. In the spasmodic anæmia, followed by cyanosis, of hysterical women, or at the climacteric period, arsenic has appeared to the writer to be by far the most useful medicine. *See* RAYNAUD'S DISEASE.

J. F. PAYNE.

CIRRHOSIS (κιρρός, yellow).—SYNON.: Sclerosis; Fibroid Substitution; Fibroid Degeneration; Chronic Interstitial Inflammation; Fr. *Cirrhose*; Ger. *Cirrhose*.

DEFINITION.—The term 'cirrhosis,' which was originally invented to describe a particular state of the liver, has now acquired a more extended meaning, and is applied to similar morbid processes affecting other organs, though the name itself, derived as it is from the yellow colour of the liver in this disease, ceases to be properly applicable. Cirrhosis may be regarded as a chronic non-suppurative inflammation affecting the interstitial, connective, and supporting tissues of the different organs, and not those by which the proper physiological function is performed.

ANATOMICAL CHARACTERS.—The process begins, after a more or less protracted hyperæmia, by the appearance in the interstitial tissues, between the proper functional elements, of small lymphoid corpuscles or leucocytes, which are arranged in lines or tracts interpenetrating the affected organ. These corpuscles crowd the tunica adventitia of the small vessels, the lymph-spaces, and the cavities in which the connective-tissue corpuscles lie; and when present in considerable amount appear to the naked eye as narrow lines of a slightly translucent greyish material. This condition was formerly termed cellular hyperplasia of the connective tissue, and the corpuscles themselves were supposed to originate from proliferation of the connective-tissue corpuscles. More recent researches have, however, rendered it probable that in inflammation the connective-tissue corpuscles remain passive and take no part in the formation of new cells. The early stage of cirrhosis is perhaps therefore more correctly described as cellular infiltration of the connective tissue, the cells themselves being white blood-globules which have emigrated from the vessels, and their descendants. The amount of this cellular exudation varies very much in different organs in the different forms of the disease. In many cases of cirrhosis of the liver, and in the fibroid induration of the left ventricle of the heart, and of the pylorus, it is very considerable, and causes much increase in the bulk of the affected organ. In other instances, as in some forms of granular kidney, it may be extremely small, and the indurated fibrous tissue consists in great part of the withered remains of the vessels, ducts, &c. of the organ.

The later stages of the process consist in the conversion of these tracts, which may be looked upon as closely analogous to ordinary granulation-tissue, into fibrous tissue. A more or less fibrillated intercellular substance appears; the corpuscles diminish in number; the remaining ones become in part elongated and oat-shaped, and some may pass into true spindle-cells, or become stellate: in cirrhosis of the lung tracts of true spindle-cell tissue are often met with. In the liver, where much of this new tissue is often formed, numerous blood-vessels become developed in it; they are devoid of distinct walls, and consist merely of channels lined by endothelium. The fibrous tissue which is the final result of the whole process closely resembles ordinary cicatricial tissue; it is usually tough, dense, and imperfectly fibrillated, with a strong tendency to contract. Sometimes, especially in the suprarenal capsules, and less frequently in the liver, portions of it consist of a reticulated connective tissue.

The *effect* of this series of changes on the proper physiological tissue of the organ is to cause its atrophy. This is partly due to the direct pressure of the new-growth, when it is formed in large quantities, but chiefly to the constriction of the contracting fibrous tissue and the consequent obliteration of the blood-vessels; for even where, as in the liver, new vessels are developed, the original vessels of the organ become obliterated. The atrophy of the proper tissue of the organs appears to take place by a gradual process of granular and fatty degeneration, followed by absorption.

PATHOLOGY.—If we now proceed to inquire into the nature and causes of these forms of chronic interstitial inflammation, the question arises whether this irritative hyperplasia of the connective tissue is primary, or whether it is the result of some preceding change in the parenchyma of the affected organ.

In the analogous condition of sclerosis of the central nervous system it can hardly be doubted but that the latter is the case; so also in cirrhosis of the lung, the interstitial changes in most cases are preceded by inflammation of the lining membrane of the bronchial tubes and air-cells. In other organs, as the liver and kidney, the interstitial change is usually considered to be primary, but this cannot be looked upon as certain.

The cause of cirrhosis seems always to be some form of protracted irritation of a low degree of intensity producing a chronic hyperæmia, functional or mechanical. As examples of this may be mentioned cirrhosis of the liver, which results from the congestion produced by spirit-drinking; sclerosis of the grey matter of the cerebral convolutions after protracted maniacal excitement; cirrhosis of the lung, the result of prolonged inhalation of irritating dust in the various forms of grinders' and miners' phthisis; the cirrhotic thickening of the pylorus in chronic catarrh of the stomach; and cirrhotic affections of the lungs and heart extending to these organs in chronic inflammation of their serous coverings. A mere passive congestion, however, if long-continued, may cause a simple hypertrophy or overgrowth of the interstitial connective tissue, and more or less induration in consequence. Still, it does not appear to have the same tendency to excite active proliferation and the formation of the contracting fibrous tissue characteristic of true cirrhosis. The exception to this rule is that we usually meet with a slight degree of the cirrhotic change in cases of 'nutmeg' atrophy of the liver, due to prolonged passive congestion of the hepatic venous system.

Chronic tuberculosis of the lungs often gives rise to extensive interstitial fibrous induration, the so-called fibroid phthisis. Visceral syphilis also may produce changes which can hardly be distinguished from other forms of cirrhosis. Even the typical gummata originate in and are surrounded by tracts of cirrhotic induration; and in other cases, where true gummata are not formed, the only difference between syphilis and true cirrhosis is that in the former there is a greater accumulation of the new-growth at particular points, and a less general diffusion of it through the affected organ. Lastly, in some cases, as in the cirrhotic liver of hereditary syphilis, the two conditions cannot be distinguished. W. Cayley.

CIRRHOSIS OF LIVER, LUNG, &c.—*See* Liver, Lung, &c., Diseases of.

CIVIL INCAPACITY.—A chief cause of civil incapacity is mental weakness or disease, and it is one of the duties of the physician to aid in determining the existence and nature of such conditions. There is a kind of incapacity which is implied in the restriction of a person's liberty when he is placed under care in an asylum or other special place for treatment. The necessary information regarding this will be found in the article, Lunacy, Laws of. But the question of incapacity is more directly raised when it is proposed that a person should be declared unfit to exercise his civil rights, to require the shield of the law to prevent his being imposed on, and to obtain special protection for his property. Medical evidence must be taken if it becomes necessary for a Commission of Lunacy to be issued by order of the Lord Chancellor. This is a proceeding which ought not to be adopted if it can properly be avoided. But until a person has been found lunatic by inquisition he is, though placed in an asylum under regular certificates, not debarred from exercising his rights in the disposal of his property. The acts of any person either in or out of an asylum may, however, be declared invalid if it can be shown that at the time they were performed the person laboured under such form of insanity as rendered him incapable of performing them rationally and without harmful consequences. On this principle any person may be found to have been incapable of contracting marriage, of executing a deed, contracting a debt, making a will, or giving credible evidence. The principle, it must be carefully noted, is not that the mere existence of insanity in the person performing them invalidates such actions, but that if the insanity has materially affected the character and quality of the actions they may be thereby invalidated. This is one of the most important principles that a medical jurist has to keep in mind, as it is not an infrequent mistake to suppose that a person is necessarily incapacitated from the performance of every civil act the moment he can be proved to labour under any condition to which the term insanity may be applied. Perhaps the case in which the validity of a civil act is most easily endangered by the existence of any form of insanity is the contract of marriage. This proceeding is supposed to so affect the whole relations of life, that almost any form of unsoundness of mind may be sufficient to interfere with that intelligent and deliberate consideration which is essential to the giving of rational consent.

The different kinds of mental disease will be found described elsewhere (*see* Insanity), and it is necessary that the practitioner, when dealing with medico-legal questions, should be fully acquainted with them. But it is chiefly important that he should distinguish the two following classes: (1) diseased perversion of the mental faculties; and (2) weakness or enfeeblement of these faculties, resulting either from defective development, disease, or decay. The first class includes all kinds of insanity which are the result of active disease. These would include the simple forms of delirium, mania, melancholia, and monomania; as well as the similar primary conditions which are found in general paralysis, and other diseases which present maniacal, melancholic, or monomaniacal symptoms. It is in this class that the special knowledge of the physician can be most successfully applied in aiding the administration of justice. In order to establish the incapacity of a person said to labour under any of these forms of disease, it must be necessary that an experienced physician should not only be able to detect their characteristic symptoms, but also to show that the performance of the duties or the exercise of the rights under consideration would be modified or obstructed by the existence of such disease. The second class includes congenital imbecility, and all the forms of what is called chronic dementia—all those enfeeblements of mind which are sometimes the remaining effects of acute disease, sometimes the concomitants of chronic disease, and sometimes only the mental phase of senile decay. Here, again, the information which may be communicated by the physician must be of great importance. But in estimating the extent to which a condition of mere mental weakness will disable a person from the performance of a certain class of actions, there so much special medical knowledge is not required as is necessary in the consideration of more active disease.

Marriage.—As has been already stated, the mere existence of any form of insanity in one of the parties may render a contract of marriage void. In one case which terminated in this manner, a man who had been insane, and when in that state had voluntarily contracted marriage, instituted the suit himself.

Civil Contracts.—These may be held binding although made by lunatics. If the person with whom a contract is made had no knowledge that the person contracting was insane, and if no attempt was made to take undue advantage of him, the contract would be held good.

Wills.—A person is considered to be of a disposing mind—that is, capable of making a valid will—if he knows the nature of the act which he is performing, and is fully aware of its consequences. It is in regard to the making of wills that the law has carried out most thoroughly the principle, that the validity of an act ought to be maintained in cases of insanity, unless at the time the act is performed the state of mind of the agent can be shown to render him unfit to perform that particular act in a rational manner. Persons have made valid wills while inmates of lunatic asylums. And one will was held to be good though the testator had committed suicide within three days after its execution. The existence of delusion which has been regarded by lawyers as of such importance in cases of alleged insanity does not invalidate a will; for it has been declared to be 'compatible with the retention of the general powers of the faculties of the mind,' and to be 'insufficient to overthrow the will, unless it was calculated to influence the testator in making it.' On the other hand, a will may be invalidated on account of the existence of mental states which would not be regarded as insanity from either a legal or medical point of view. Drowsiness and stupor resulting from erysipelas or fever, extreme weakness from cholera or other disease, and failure of memory in old age, have been sufficient to render wills void. It frequently happens that a medical man is called on to be witness to a will. On such an occasion it is his duty to satisfy himself as to the testamentary capacity of the testator. His subsequent evidence in regard to this, will, in case of dispute, be of almost decisive influence, if he has taken proper means of forming an opinion. In all cases, therefore, where there may be a possibility of doubt, it is well to require the testator to show that, without extraneous aid, and without referring to the document itself, he remembers and understands all the provisions of the deed

Evidence of the Insane.—Lunacy was, till a recent date, regarded by the law as incapacitating a patient from giving evidence in court. But according to the much more extended signification which the term lunacy has received, it now includes states of mind which are looked on as compatible with testimonial capacity. Where the judge is satisfied that the lunatic understands the obligation of an oath, and can give a rational account of such things as happen before his eyes, the evidence may be admitted. But the weight to be attached to such evidence will still depend on the extent to which it fulfils the conditions commonly required to constitute credibility. It has been held, however, that when a person has suffered from an attack of insanity between the occurrence of the transaction and the time he tenders his testimony, his evidence cannot be admitted.

Management of Property.—Where persons are supposed to be unable, from unsoundness of mind, to undertake the management of their own property, it may be necessary that they should be placed under the protection of the Court of Chancery; but this proceeding is not usually had recourse to unless there is urgent necessity, or a strong probability that the person's incapacity will be permanent. It is consequently resorted to chiefly in chronic or congenital cases where there is no room for doubt as to the mental condition of the individual; and in cases of recent insanity, where it is necessary to have recourse to an asylum for the protection of the individual, it may also be necessary to obtain protection for his property by the aid of the Court of Chancery. In giving evidence or framing a statement in such a case, it is important, if incapacity is to be proved, to show that the individual has been found, when placed in circumstances requiring such capacity, unable to perform the acts which the management of property necessitates. In cases of active insanity it is especially required to show, not merely that there is delusion or other symptoms of insanity, but that the insanity is of such a nature as specially to disable the person from duly performing the duties which would be required of him. Difficulties most frequently occur in cases of imbecility and dementia; but the verdicts in such cases, when disputed, will generally be found to rest rather upon the impression produced by evidence of the actual behaviour of the individual, than upon the mere medical view of his mental condition. The most effectual aid that the medical witness can render in such cases, is to show whether there are or are not such peculiarities in the conduct of the person under inquisition as are known to be characteristic of imbeciles or demented persons. In undisputed cases, where the duty of the medical man consists merely in making an affidavit, there is no special difficulty to be encountered. Brevity, scrupulous accuracy, and attention to the fact that such unsoundness of mind as involves incompetency to manage property must be established, are the most important requirements. A person found by the court to be incapable is placed under the control of a 'committee of the person,' and the property under a 'committee of the estate.' In Scotland, proceeding by petition to the Court of Session, or, in the case of small estates, to a sheriff, for the appointment of a *curator bonis*, takes the place of the English inquisition. The chief peculiarities of the Scotch process are that it is cheaper, more easily effected and more easily annulled, and that it does not affect the person of the lunatic. The functions of the curator correspond to those of the committee of the estate in the English court. The Scotch procedure for the appointment of a guardian of the person was virtually in desuetude until the passing of a recent statute (31 & 32 Vict., c. 100). Under this Act a brieve for the cognition of an alleged lunatic is issued from Chancery, and tried before a judge of the Court of Session and a special jury. The procedure is similar to that of jury trials in other civil causes in Scotland, and both medical and other evidence must be produced. If the person so cognosced be found 'furious, fatuous, or labouring under such unsoundness of mind as to render him incapable of managing his affairs,' his person is placed under the guardianship of the nearest male relative found competent.

Drunkenness.—This condition is not held to deprive a man of civil capacity unless it has at the time rendered the individual unconscious of what he was doing.

John Sibbald.

CLAP.—A popular name for gonorrhœa. *See* Gonorrhœa.

CLAREMONT, in Cape Colony.—*See* Africa, South.

CLAVUS HYSTERICUS (*clavus*, a nail).—An acute pain, often associated with hysteria, but occurring also in other conditions, which is felt in a localised point in the head, and is compared by the sufferer to the sensation that might be produced by a nail being driven into the part. *See* Hysteria.

CLIMACTERIC (*κλιμακτήρ*, a step of a ladder).—This word, which properly signifies 'by degrees,' was originally employed to indicate certain epochs or periods in the life of an individual, which were looked upon as critical, and at which the body was supposed to have undergone a complete change, so that it had become entirely renewed in its structural elements. The years in which these epochs terminated were called climacteric years—*anni climacterici*—and their number was variously estimated. Thus, some only recognised three climacterics; the Greek physiologists held that there were five, ending at the seventh year, the twenty-first (7 × 3), the forty-ninth (7 × 7), the sixty-third (7 × 9), and the eighty-first (9 × 9); others made them multiples of seven or nine, or multiples of seven by an odd number. Most regarded the sixty-third year as the *grand climacteric*, but the Greeks recognised two grand climacterics, terminating respectively at the sixty-third and eighty-first years, and this special denomination was given because there was little, if any, prospect of life being extended beyond these periods. At the present day the word 'climacteric' has lost much of its original meaning, and is generally applied to certain times of life, without any reference to numbers of years, at which marked physiological or developmental changes occur, such as the period of puberty, or that of the cessation of menstruation.

A particular *climacteric disease* has been described, which is said to occur either about or subsequent to the sixty-third year or grand climacteric, and supposed to be distinct from the natural decay and degeneration which takes place in advanced life, inasmuch as recovery often ensues. It is stated that the complaint comes on suddenly, but advances insidiously, the symptoms being at first loss of flesh and weakness, followed by loss of appetite and dyspeptic symptoms with a white tongue, which are regarded as sympathetic, sleeplessness or disturbed and unrefreshing sleep, constipation, pains in the head and chest, a frequent pulse, swelling of the legs, and an emaciated or bloated appearance of the face. The urine does not present any abnormal characters, and most of the viscera seem to perform their functions properly. Whether there is any independent disease deserving this special denomination is, in the writer's opinion, extremely doubtful.

Frederick T. Roberts.

CLIMATE.—Formerly the word climate (from the Greek word *κλίνω*, I incline) was a term of astronomical or mathematical geography, which implied a portion or zone of the earth's surface comprised between two lines parallel to the equator, and measured by the length of time during which the sun there appears during the summer solstice, that is, by the sun's inclination. The space between the equator and the pole was divided into half-hour climates, in which the length of each day increased by half an hour; and also into monthly climates. This unequal division of each hemisphere is now replaced by a division of the interval between the equator and the poles into ninety degrees, which constitute what are called degrees of latitude, and the word 'climate' has received a more extended application.

By climate is now understood those conditions of heat, moisture, atmosphere, wind, soil, and electricity, which impress certain conditions, uniform even when apparently irregular, on given portions of the earth's surface, and which modify, also in a uniform manner, vegetable and animal life.

Classification.—Climate, when thus interpreted, is still principally dependent on astronomical facts, on the sun's position or inclination with regard to the earth, and on the amount of heat it supplies to different portions of the surface of the latter. Climate may be studied generally and locally. The division of the earth's climates is necessarily arbitrary, and many different classifications have been proposed. The most simple is that which recognises three principal kinds of climate, each susceptible of subdivision, viz.: *warm* climates from the equator to 35° lat.; *temperate* climates from 35° to 50° or 55° lat.; *cold* climates from 50° or 55° to the pole. As subdivisions we may recognise equatorial, tropical, sub-tropical, sub-polar, and polar climates; and also *insular* and *maritime* or moist climates, and *continental* and *mountain* or dry climates.

1. Warm Climates.—Warm climates, extending from the equator to 35° lat., that is, 12½° beyond the tropics, comprise nearly all Africa and its islands, South Asia, most of the islands of Polynesia, and the portions of North and South America comprised between California and the north of the La Plata territory. In the equatorial regions the medium temperature for the year is from 80° to 84° F., the min. being 54°, the max. 118°. Near the equator the annual mean temperature decreases slowly as we recede from it, the decrease not amounting to more than 2° F. for the first 10° lat. The difference of temperature during the day is slight, but much greater during the night, owing to radiation. The general variations of the barometer are slight, but the periodical or diurnal variations are very marked. It ascends and descends regularly twice in the twenty-four hours. It ascends from 4.13 a.m. to 9.23 a.m., and descends until 4.8 p.m., ascending again until 10.23. Electrical phenomena are very decided. The rainfall is variable, but 40 inches may be given as a mean. It is generally supposed that heat is greatest at the equator, and diminishes as we recede from it; but both observation and astronomical induction lead to the conclusion that not only the maximum of temperature in warm climates is attained at or near the tropics, but also the highest annual mean. The countries in which the highest degree of heat is known to be attained are near the tropic of Cancer, as, for instance, the banks of the Senegal, the Tehama of Arabia, and Mehran in Baluchistan. Moreover, the snow-line, or the line of perpetual snow, is higher at the tropics than at the equator. In the Bolivian Andes, near the tropic, it is 17,000 feet, whereas in the Ecuador Andes, on the equator, it is only 16,000 feet. These facts are partly explained by the unequal progress of the sun after the equinox in its course towards the tropic. In the first month it passes through 12° of latitude, in the second month through 8°. At the end of the second month, therefore, it is 20° from the equator, and there remain only 3½° to be traversed in the third month. The sun receding from the tropic at the same rate at all places between 20° and 23½° of latitude, the solar rays during two months fall at noon either perpendicularly or at an angle which deviates from a right only by 3½° at most.

Another cause which tends to diminish heat in the regions near the equator is the prevalence of rain. For about five degrees north and south of the equator, in the region of the equatorial calms, there are few consecutive days in the year without rain. The principal cause both of the calms and of the rains has been attributed to the meeting in the upper atmospheric regions of the trade winds, north and south. They neutralise each other, and precipitate the vapour they hold in solution.

Regions that lie between 5° and 10° of latitude have usually two rainy and two dry seasons. The greater rainy season occurs when the sun in its passage to the nearest tropic passes over the zenith, lasting from three to four months. The lesser rainy season occurs when the sun on its return from the nearest tropic approaches the parallel of the place. The rains then only last from six weeks to two months, and are much less abundant and continual. Countries more than 10° or 12° from the equator have only one rainy and one dry season; the first begins when the sun approaches the nearest tropic, and ends some time after, when in its course from the tropic it has passed the parallel of the place. It lasts from four to six months. Local conditions may modify the course of the dry and wet seasons, as is the case in India, where the dry and rainy seasons depend principally on the monsoons. The amount of rain that falls in a short time within the tropics is very great, much more so than in more northern regions, but these heavy rains do not last continuously, as is supposed. Days of continued rain, even in the rainy season, are rarer than in the north. Still, heavy rains are apt to cause great inundations, and to cover large extents of low or level country with water, producing swamps and marshes, very injurious to health.

In the vicinity of the tropics there is a belt, extending over several degrees of latitude, where it seldom rains. This rainless tract is precisely the region which has been already mentioned as that of greatest heat. These belts of rainless regions, extending around the globe on each side of the equator, may be said to separate the countries which lie on each side of the equator from the temperate zones. Thus in Africa the rains cease on the southern border of the desert of Sahara at about 16° N., and begin again at 28° N. On the banks of the Nile the rain ceases about 18° or 19°, to begin again between 28° and 29°. The Tehama, or low coast of Arabia, is all but rainless. This rainless tract crosses Asia as far as China, where there is no rainless region, owing, probably, to the fact that all parts of China between 22° and 30° N. lat. are traversed by high mountain chains.

The influence of warm climates impresses certain peculiarities on the people who inhabit them. They are the abode of the Ethiopian and Mongolian races of mankind, and appear to have impressed the same characteristics, in a minor degree, on the Caucasian races that inhabit them: a dark complexion and black hair. The inhabitants of these countries are indolent and apathetic. The functions of the skin and liver are peculiarly active, a circumstance which exposes them to severe disease of these organs. The digestive functions are sluggish, and the nervous system is alternately excited and depressed. Remittent and intermittent fevers, dysentery and yellow fever, are common. During the dry season disease tends to assume the ataxic, during the rainy season the adynamic form. Pulmonary consumption is frequently met with in the towns, in contradiction to received opinions.

2. **Temperate Climates.**—Temperate climates may be said to occupy the zones of the earth's surface comprised between 35° and 50° or 55° lat. They comprise Southern and Central Europe, with its islands; the parts of Asia which extend between the Black Sea and the Mediterranean on the west, and Japan on the east; the greater part of North America; a part of Chili and La Plata and Patagonia in South America. The mean temperature may be stated at from 60° to 50°. The climates in which the mean temperature is from 60° to 68° are often spoken of as temperate, but in reality they approximate closely to warm climates. The four seasons, winter, spring, summer, and autumn, are well-marked, but are very variable both as to barometrical and thermometrical conditions. The mean temperature in the central regions is, for winter 38°, for spring 51°, for summer 68°, and for autumn 53°. The regions which are near the south and north limits of the northern temperate zone approximate to the meteorological characters of the warm and cold climates respectively. The periods of the year when storms, rain, and general versatility of meteorological phenomena are principally observed correspond with the vernal and autumnal equinoxes.

The influence of a temperate climate on the human organisation is salutary, extremes of heat and cold being both trying. Thus the healthiest climates of the world's surface are found in this zone. Intense heat, or even moderate heat if persistent, throws a physiological strain on the liver, skin, and digestive system, and renders mankind prone to severe and fatal diseases of these organs. Intense cold throws a physiological strain on the lungs and kidneys, and exposes them also to severe and fatal disease. The healthiest temperate climates are those in which the winter is not very cold and the summer is not very warm, and in which, consequently, there is no great or continued strain on any one class of organs. The diseases of temperate regions are those that are the best known, as their study and description constitute the foundation of pathological science, ancient and modern.

The climate which, perhaps, the best deserves the appellation of temperate is that of the Mediterranean basin. The winters are not severe on any part of its north shores, and the summers are not intensely hot on its south shores; at least the heat falls short of that of the tropics. There are many conditions of physical geography which conduce to this result. The north shores are protected from north winds by the ranges of high mountains of Southern Europe which skirt them, and the south shores are in close proximity to the hot, rainless tract of Northern Africa—the desert of Sahara, which favourably modifies winter temperature. Moreover, the Mediterranean is a warm sea, but few cold rivers of considerable size flowing into it from the north, a fact which increases the temperature on its shores and islands.

3. **Cold Climates.**—Cold climates comprise the regions which extend from 50° to 55° lat. to the poles. They may be subdivided into *cold*, with a mean of from 50° to 40°; *very cold*, with a mean of from 40° to 32°; *glacial*, with a mean below the freezing-point. In the austral hemisphere the zone contains but little known land, although the existence of an antarctic continent is suspected; in the northern hemisphere it comprises, in Europe, the north of Scotland, Denmark, Sweden, Norway, Iceland, Finland, Lapland, Northern Russia, Spitzbergen, Nova Zembla; Northern Asia, and some of its large plains below 50° lat., Siberia, and Kamtchatka; in America, Canada, including some regions below 50°, the northern lands and islands of Hudson's and Baffin's Bays, and Greenland. In this zone the decrease of the mean temperature is much more rapid as we recede from the equator, than it is in the tropical regions. Thus from the equator to 20° lat. the variation of the mean temperature is not more than 7° or 8°, whereas the variation between 55° and 75° lat. amounts to from 22° to 27°. The coldest region of the globe is not, it would appear, at or near the pole, but at about 80° lat., or 10° from the pole, north of Behring's Straits: the cold of the glacial climates has been exaggerated. At the lati-

tudes of from 70° to 78°, the extreme limit of human habitation, the mean annual temperature is between 19° and 17°, *i.e.* 13° to 15° below the freezing-point. The extreme of cold registered, however, reaches a hundred degrees or more below the freezing-point. Owing to astronomical conditions there is great disproportion between the length of the nights and of the days at different seasons of the year. In the more northern regions, for several months in the winter the sun never appears above the horizon, and in the summer for several months the sun never disappears below it. Spring, during which the extreme cold is mitigated, lasts but a very short time, and is succeeded by summer, which is in its full strength in June and July. Temperature rises rapidly from 35° to 55° and 60°. In some northern localities it rises to 86° or 90°. Under the influence of the prolonged or persistent days, and of the increased temperature, the vegetation peculiar to each locality passes through all its phases with extreme rapidity. Towards the end of July rain and fog reappear, and are followed by snow and intense cold, the highest expression of which is in January and February. The barometrical changes are the reverse of what obtains in the tropics. Above 60° lat. the diurnal or periodical changes are scarcely perceptible, whereas general or occasional variations become more marked as we approach the pole. Electrical phenomena become less marked, and abovo 68° lat. they are scarcely perceptible, with the exception of the aurora borealis. The winds which predominate are the N.E. and S.W., and they change rapidly from one point of the horizon to the other, and thus frequently occasion tempests which extend over considerable areas. The quantity of rain that falls in cold climates is much less than in the tropical and temperate, with some exceptions. Between 60° and 90° lat. it only amounts to a few inches, and falls principally in the form of snow.

The influence of cold climates is shown on the inhabitants of these countries, who vary much in stature, and possess a vigorous constitution, a sanguineous temperament, great muscular development, active digestive functions, and sluggish nervous powers. Notwithstanding the severity of the climate, they generally succeed in preserving health, and live to old age, presenting few diseases referable to climatic influences. They are, however, subject to ophthalmia and amaurosis, owing to the reflexion of light from the snow in tho polar regions, and to scrofula and scurvy, the result of a poor and incomplete dietary. Agues and intermittent fevers from marsh influences are rare, and not severe, and disappear entirely as we approach the pole. Continued fevers are met with, but seldom if ever epidemically.

4. **Insular Climates.**—Insular climates present important peculiarities. The temperature of the sea is more equable than that of the land. Owing to the action of currents, and to the circulation of its waters under the influence of heat, its superficial temperature is warmer in winter and cooler in summer —more equable—than that of the land. It has thus a tendency to warm in winter and to cool in summer the island which it surrounds. Moreover, there is constantly watery vapour arising from the sea, which extends to island atmospheres, veils the sky more or less, shields the surface from the ardour of the sun in summer, and prevents great radiation both in summer and in winter. Thus it is that the climate of all islands is more equable than that of continents. This fact is more especially recognisable in the climato of the British Isles, which is also modified—rendered warmer and moister—by the waters of the Gulf Stream impinging on their shores. The warm Gulf Stream, commencing in the tropics, in the Gulf of Mexico, passes northwards along the shores of North America, crosses the Atlantic to the south of Newfoundland, and strikes the shores of the British Islands, of Norway up to Cape North, of Holland, and of France; everywhere raising temperature and the annual mean.

5. **Maritime Climates.**—Maritime climates participate in these influences: temperature is more equable, warmer in winter and cooler in summer, on the shores of seas and oceans than it is inland. Owing to this cause most of tho winter sanitaria have been chosen in islands or on the coasts of oceans and seas: such as Hastings, Ventnor, Bournemouth, Torquay, Funchal, Malaga, Cannes, Nice, Mentone, Naples, Salerno, and Algiers.

6. **Continental Climates.**—Continental climates exhibit conditions the reverse of those which obtain in maritime climates. The tendency is to cold winters and warm summers, owing principally to the absence of the equalising influence on temperature of large masses of water. A very short distance from the sea is sufficient to establish this difference. Thus the central parts of France are very much warmer in summer and colder in winter than the coasts of Normandy and Brittany. But it is when we reach the centre of continents — Russia, Central Asia, Central America—that the difference is the most marked.

7. **Mountain Climates.**—As wo rise above the level of the sea, we meet with two important meteorological conditions. The air becomes more and more rarefied, and the heat diminishes, independently of the more or less obliquity of the sun's rays. The higher we rise above the sea-level the more the air is rarefied, and tho more the degree of heat due to the solar rays diminishes. We arrive at last, even at the tropics or the equator, at a height, variable according to

latitude, where the sun's heat is insufficient to melt the snow. This is termed the snow-line. Mountains attract clouds and watery vapour, and the coolness of their atmosphere causes the precipitation of the vapour in the form of rain or snow. Thus, mountains, mountain-ranges, and the glaciers they contain, are the principal cause and origin of rivers.

The influence of mountain climates, notwithstanding the clouds, fogs, and rain which characterise them, is proverbially a healthy one, owing to the purity of the air, the shelters found in the valleys, and, perhaps, to the sparseness of population. They have of late been much recommended for phthisis. The conditions above mentioned, together with sunshine to a limited extent, are quite sufficient to account for the rarity of phthisis amongst their inhabitants, and for the improvement of the phthisical who resort to them.

Soil modifies climate considerably. Wet and marshy soils are cold, engendering fog and mist. Sandy, dry, well-drained soils are comparatively warm. All sandy plains are warm in summer and cold in winter.

Such are the features which characterise the climates of the terrestrial globe, generally. Each locality, however, each mountain, plain, and valley, each city, village, and house has a climate of its own, modified by all the meteorological elements which we have successively considered. To discover what each climate is, we must study carefully the meteorological conditions and influences which we have rapidly surveyed in their application to it.

Isothermal Climates.—Owing to the unequal influence of the different elements that constitute climate, the annual mean temperature of regions occupying the same latitude on the earth's surface is very variable. Hence the above name has been given to the regions in which the annual mean is the same. The study of a map on which the isothermal lines are marked is an instructive illustration of the facts above described. Thus it will be seen at a glance that the limit of constantly frozen ground in the central plains of Asia and in the northern plains of America is below 54°, which is the latitude of York!

THE GENERAL INFLUENCE OF CLIMATE.—The vegetable and animal worlds, including man himself, have been modified in essential characters by climatic conditions. The study of its influence on their vitality and organisation opens out a wide field to the observer. This study leads to the conclusion that geological periods of time have been necessary to impress on terrestrial life, be it vegetable or animal, the characteristics observed now or formerly in the climates of different regions of the earth. The current of modern research is strongly directed to the elucidation of the influence of climate on life during such geological periods. The investigations of Darwin and his followers may be named as the most remarkable and important illustration of this fact. We may also mention the researches of modern philologists, which have proved, by the study of languages and their roots, that most of the nations of modern Europe have descended from the same Aryan parents as the inhabitants of the Indian peninsula. Climate, in the course of time, has so modified them as apparently to produce different races. For such a change to take place geological lapses of time are certainly required. Our earliest records, dating back several thousand years, show these races, such as they are now, quite as distinct. In these days the Aryan races of Europe cannot rear their children in the climate of India, where their Hindoo relatives thrive and propagate their species. In Palestine and Egypt the biblical records, those of the Pharaohs, and those of Nineveh and Babylon, show these regions to have been inhabited, several thousand years ago, by nations and tribes presenting precisely the same race characteristics as those that now inhabit them. During the historical period, the races of Europe have in vain endeavoured to colonise the valley of the Nile; for they have not been able to propagate their species, and have died away, leaving the valley of the Nile to its ancient inhabitants. Their children cannot withstand the heat of summer. On the north-eastern shore of Africa, the Algeria of the present, history presents the same record. The Romans and the Visigoths occupied its plains for centuries, continually recruiting their colonies from the mother-countries; and yet, except in the mountains, all trace of their presence has disappeared. They could not rear their children so as to occupy the land of the Arabs. What lengthened periods of time must have elapsed to so profoundly modify races deriving their origin from a common parentage, that they can no longer live and propagate their species in the same climates!

THERAPEUTICAL APPLICATIONS.—The therapeutical application of many of the above facts is contained in the facts themselves. Reasoning suffices to deduce the therapeutical law, and experience proves the correctness of the deduction. Only a very brief summary can here be given. *See* also CLIMATE, Treatment of Disease by.

Firstly, it is clear that if a local climate produces injurious effects on the health of its inhabitants, or of visitors, the latter should leave it, and the regular inhabitants, who cannot leave it, should endeavour by every possible means to modify the pernicious climatic influence to which they are exposed, and to partially escape from its action. This rule may be illustrated by the influence of confined mountain valleys in producing goître, and of marshy districts in producing intermittent fevers. The principle applies to all local climates which exercise a pernicious influence of any kind on the human organisation. When possible the climate should be abandoned; if that is impossible, its pernicious influence must be combated by every possible hygienic and therapeutical means.

The injurious effects which extreme climates exercise on the human economy—warm climates on the abdominal and cerebral organs, cold climates on the thoracic—point to change of residence as an important therapeutical agent, the value of which is only beginning to be understood. Our naval and military surgeons have done much to clear up this branch of therapeutics, as regards the diseases of tropical regions. Thus chronic affections of the liver and intestines, incurable n a warm climate, often become quite curable if the patient is transferred to a temperate region or to a mountain elevation in the tropics, which reproduces a temperate climate.

Inversely, persons suffering from diseases of the respiratory organs, so common in damp temperate climates like those of France, England, and Holland, find relief by migrating, especially during winter, to warmer regions of the earth's surface, where they escape from the influences which have proved so detrimental to them. Thence the yearly increasing exodus of persons suffering from chronic laryngitis and bronchitis, from bronchial asthma and from phthisis, from the north of Europe to the south.

The increased facilities of locomotion, by rail and by steam, have thus opened out, as it were, a new and important branch of therapeutics, that of the application of climate to the treatment of disease.

J. HENRY BENNET.

CLIMATE, Ætiology of.—*See* DISEASE, Causes of.

CLIMATE, The Treatment of Disease by.—Though we can scarcely say with accuracy that change of climate is a specific for disease, yet much can be effected by it in relieving symptoms, and in assisting the recuperative powers of the organism by thus improving the general health. The diseases in which change of climate has been found of value will be enumerated below, with a short notice of various climates. Here we may notice the *rationale* of the benefit to be derived from such change.

Change of climate, we must premise, is only a relative term. It does not necessarily involve the idea of removal to a great distance from the patient's home. A few miles' journey from the town to the country, from inland to the seashore, from the plain to the mountain, often suffices to produce marked results. One use of climate being to expose the organism to the effects of *contrast*, the element of distance comes in most when we wish to make the contrast greater; for instance, in ordering change from a cold to a warm climate or *vice versa*.

The therapeutic elements of most importance in any climate are: (1) pure air, free from dust and organic particles, or excessive damp; (2) abundance of sunshine, without excessive heat, so that much time can be spent in the open air; (3) a temperature without extremes, so that the body is not exposed to the risk of great variations of heat and cold—equability; (4) absence of violent, very cold, or very hot winds, at any rate of long duration (in this is involved the element of local shelter).

These four elements should be present in each of the subdivisions of climates which a therapeutic classification renders necessary, namely, climates of: (1) *the seashore*; (2) *mountains*; (3) *inland wooded districts*; and (4) *the open sea.*

The epithets 'moist' and 'dry,' which are applied to climates, are merely relative, and depend on local peculiarities of rainfall, soil, &c., as well as to some extent on season; and the essential differences between the climate of the seashore, the woodland, and the mountain remain everywhere the same. We shall say a few words about each of these, with the indications for their use. The climate of the open sea will be referred to in speaking of sea voyages.

1. Climate of the Seashore.—The special peculiarities of this variety of climate are that the air is saturated with moisture, except when dry land winds prevail; it is dense. and, as a rule, therefore, bulk for bulk, contains more oxygen than air of any higher level; its density is liable to great and frequent but regular variations, which increase the activity of the circulatory and respiratory organs, and thus favour their functional activity; it is more equable; and, lastly, it contains saline particles in suspension.

According to Beneke, sea air cools the body relatively more quickly than mountain air, and thus hastens more the processes of tissue-change. Hence, the seaside should be ordered where we wish for a highly stimulating effect, as in persons of scrofulous tendency, in chronic succeeding acute diseases, or in the later stages of convalescence from the latter, in convalescence from surgical operations, or in some surgical diseases where we wish to accelerate tissue-change, without exertion on the patient's part. On account of the equability of the climate, some patients who cannot bear great changes of temperature do well at the seaside. Persons suffering from overstrain, mental or bodily, with a fair digestive power, and not liable to nervous irritability, may also be sent there.

2. Mountain Climates. — Mountain climates are distinguished from seaside climates by the lower density of their atmosphere; their lower and less equable temperature; by less humidity, though, owing to local winds, mist and cloud often form; and by relatively lower night-temperatures in clear weather, owing to the dryness of the air, and consequent great radiation. They are cooler also than the inland climates of level districts, and this coolness tends to some extent to diminish the rarefaction and increase the density of their air.

The general action of mountain air is to produce a freer circulation of the blood and greater vascularity of the lungs, owing to deeper and more frequent inspirations and greater ease of bodily movement. Owing to the cooling of the body by the lowered temperature more food is required, the appetite improves, and the body becomes better nourished and gains weight.

The intensity of the effect is, broadly speaking, directly as the height. The term 'mountain climate' is applied in medical parlance to elevations in Europe of from 1,500 to 6,000 feet, though in South America patients have been sent as high as 10,000 feet, or higher.

Mountain climates are indicated: (1) in cases of hereditary tendency to phthisis in young persons with narrow, shallow chests, who are growing too fast; also in young scrofulous patients. (2) In chronic phthisis and pneumonia; remembering, however, that phthisis occurs at all elevations. The coolness of the mountain air in the height of summer is an important element in phthisical cases, which always suffer from great heat. (3) As a tonic and restorative in persons suffering from over-work in business or literary pursuits, and who have no real organic disease. (4) Generally to complete the convalescence from acute diseases of individuals not past middle life, with a fair amount of muscular power and bodily activity. (5) As a prophylactic against hay-fever, cholera, and other infectious diseases. Mountain climates are not advisable in cases of chronic bronchitis, heart-disease, emphysema, Bright's disease, chronic rheumatism, hæmoptysis, nor for aged persons.

3. Climate of Inland Wooded Districts.—The climate of wooded districts (elevations above 1,500 feet are not here referred to) is peculiar in several respects. It has a temperature lower than that of the surrounding country—on the average 3° F.—during the hours of daylight; the temperature is also more equable. The relative humidity is higher (9·3 per cent.) in summer than in the less wooded country, and hence there is greater liability to rain and mist. It also affords greater protection and shelter against winds than other climates.

The general effect of woodland climates, as may be deduced from the above, is sedative and tonic. They may be advised in chronic bronchitis, emphysema, heart-disease, and in hypochondriasis, hysteria, and other nervous affections where tranquillity and subdued light are of importance; also in the earlier stages of convalescence from acute disease when sea or mountain air is too stimulating. In bronchitis pine-woods should be selected, and in heart-cases level walks are essential, unless exercise be deliberately ordered for certain kinds of cardiac disease in the form of graduated hill-climbing.

4. Ocean Climates: Sea Voyages.—Voyages have been much recommended in the treatment of phthisis in its early stages, with a view to enable the invalid to spend much time in an exceedingly pure and fairly equable atmosphere, and to secure a sufficient amount of bodily movement without great fatigue.

The drawbacks to the sea ought to be provided against as far as possible, although certain of them from their very nature must be endured. The principal of them are the impossibility of escape from bad weather, and the confinement, perhaps, to ill-ventilated cabins, when such occurs; the absence of sufficient light and air below decks, the latter being felt very much at night; want of variety in the diet after a certain time, and in many instances of fresh food, milk, &c.; monotony in society and occupations; and, lastly, the inconveniences arising from crowding of the maindeck with hen-coops, sheep-pens, &c., and in steamers from the smoke of the engines, and the smell and vibration of the machinery.

The routes generally recommended to invalids are chiefly: (1) to Australia, 90 days in a sailing vessel, 45 in a steamer; (2) to the Cape of Good Hope, 20 days; (3) to the West Indies, 17 days; and (4) to the United States or Canada (in summer), 6 to 7 days. Short cruises in the Mediterranean, or to the latitudes of the Canaries and Azores, are suitable for certain cases where expense is no object. Of routes (3) and (4) we may say that they are too short for the full benefit of the sea to be obtained, as improvement does not generally begin for a week or two after sea-sickness has subsided, and the patient can remain comfortably on deck. Route (2) does not allow him to get the bracing effect of high South latitudes. Hence where a long sea voyage is indicated, route (1) is decidedly the best. England is quitted in the beginning of October, Australia (Sydney or Melbourne), or New Zealand (Wellington), is reached early in January, and the return voyage is begun not later than the end of February.

Patients should not remain in the coast-towns of Australia in summer on account of the heat and the dust. They should go to the table-land of New South Wales, or to the Darling Downs in Queensland, or else they should cruise from port to port, or cross to New Zealand or Tasmania.

In returning, the route round Cape Horn should be *avoided*, on account of the great risk of the climate of the South Pacific Ocean, and the chance of encountering icebergs, fogs, and unfavourable winds. Either the patient should come back round the Cape of Good Hope; or, if his strength permit, he may cross to California, travel overland to New York and thence by steamer; or, lastly, he may come by the Red Sea, Suez Canal, and Mediterranean.

The invalid must expect about 20 wet days on the voyage out. The temperatures met with range from 40° to 80° F., the coldest and most uncertain weather occurring in the North Atlantic and South Pacific Oceans.

Choice of Vessel.—The following considerations may be useful in deciding between steam and sailing vessels:—

For a steamer there is the greater certainty in predicting the length of the voyage, and the calms of the tropics are sooner passed.

Against steamers there is the nuisance of steam and smoke on deck; much space is taken up by the engines, stokers' rooms, &c., and hence other parts of the ship are more crowded; the bilge water is tainted with the engine grease; there is the wearying grind of the screw by day and by night; while more seas are shipped, because a steamer can run against a head-wind.

For sailing vessels there are the advantages of more room, light, and air in the cabins, and the absence of the above-mentioned disagreeable conditions.

Against them there is the longer and more uncertain duration of the voyage, the necessity of shaping their course by the prevailing winds, and the possibility by route No. 1 of being becalmed at the equator for days or weeks, in a humid atmosphere of 80°–85° F.

The vessel selected should not be under 1,000 tons, and her age, class of passengers, the character, temper, and standing of her captain, as well as the reputation of the owners, and the size of her cabins, should be carefully ascertained. Of course it is a *sine quâ non* that she should carry a duly qualified surgeon.

The cabin for the outward voyage to Australia should be on the port side, so as to get the breeze in hot weather, and *vice versa* in returning.

The cabin outfit should include a spring mattress, with hair (not wool) mattress over, a folding easy chair, chest of drawers, carpet, curtains, and sponge bath (Faber). Clothes of various degrees of thickness are essential, both for body and head, and a waterproof suit is necessary for bad weather.

Plenty of linen must be taken, as washing is difficult on board, and there should be a supply of preserved milk, meat or essence of meat, fruit, and light wines.

The *indications* for a sea voyage are hereditary tendency to phthisis, or the presence of actual but uncomplicated disease in a very early stage, in persons not past middle life, with a fair digestion, absence of severe pyrexia, and general health not much impaired. Patients with a tendency to hæmoptysis should not be sent, nor should those of a desponding disposition, who would thus be likely to suffer by the long absence from home, or from fears of their personal safety. Of course a tendency to protracted sea-sickness is a distinct contra-indication.

The invalid should be careful not to overtax his digestion too much; he should take regular daily exercise on deck to the extent of his strength, have some definite occupation to beguile the time, and, if possible, be accompanied by a personal friend (Faber).

Choice of a Climate—General Hints.—It is a good plan, if possible, to order a patient a climate with that mean temperature and relative humidity which he is known to tolerate well (Sigmund). The patient's disposition must be considered, and a lively or a quiet place chosen according to his temperament. We should not send a poor man to a place beyond his means, otherwise he has to grudge himself many comforts, and loses much, if not all, the benefit of the change. In sending patients to the South of Europe this rule is too often neglected.

The special indications for the climates of particular places can only be understood by studying their local aspect. Generally speaking, as far as Great Britain is concerned, the climate of the east coast is colder and drier than that of the west and south coasts. In Europe the north and west coasts are moister and cooler than the shores of the Mediterranean. As to season, mountain climates include some very important winter stations; woodland climates are almost exclusively indicated from May to the middle of July. Certain parts of the sea-coast are adapted for invalids at all seasons of the year; but as a rule the northern coasts of Europe and the eastern or south-eastern coasts of Great Britain are best suited for summer, and the south, west, and south-western for winter residence. The Mediterranean coast is only to be recommended from mid-October to the middle or end of May, and Egypt should be quitted not later than April. A word may be added as to the advantages of wintering in the South of Europe. It is incontestable that the invalid gets a milder winter, a longer autumn, and an earlier spring. Although there is no place where some days of bad weather do not occur, or where uninterrupted calms are met with, yet the number of rainy days is fewer. there is more sun, little or no fog, and, except in the neighbourhood of the Pyrenees, little or no snow or ice. The scenery is picturesque and attractive, and the invalid is able to spend much time in the open air, and to sit out of doors on many days, even in mid-winter. The drawbacks to the South are the risk of chills, owing to the difference between sun and shade temperatures, especially at first, when persons are unaccustomed to the climate, and fail to take sufficient care; the occasional occurrence of high winds, especially in spring; the more limited accommodation, owing to the expense of rooms and living; and the absence of many so-called 'home comforts.'

Those who visit the South must remember that the curative value of the climate consists in its *allowing much time to be spent in the open air,* and in its milder temperature and drier air, which protect the respiratory organs from fresh inflammatory attacks. A south room and warm clothing of the texture usually worn in England in autumn are essential, and a coat or wrap should always be carried out of doors in mid-winter to put on in passing from sun to shade. The invalid should strictly avoid the hot atmosphere of gaslit *salons* at night.

Patients with acute diseases of the respiratory organs should not be sent to the South; and high fever, excessive weakness, or the necessity of remaining in bed, are also contra-indications, owing to the fatigue and risks of the journey and the need of home comforts. Cases of mental disease with excitement, where rest and protection of the mind and body are of primary importance, should likewise not be sent.

In the convalescence from acute diseases occurring in autumn, where a cold northern winter would prevent open-air exercise, and probably set up fresh exacerbations, southern winter climates are of great value.

In ordering change of climate the accommodation, food and water supply, soil and drainage of the locality chosen, should be carefully considered, especially if the distance be a long one. The best climate may be unavailable for the invalid, owing to defects in one or more of these particulars.

Lastly, the patient's own feelings should be carefully consulted before he is sent far away from home. In some cases all the benefits of climate are counteracted by 'home-sickness.' *Cœlum non animum mutant qui trans mare currunt.*

Enumeration of Climates.—We shall now enumerate various climates and regions suitable for the treatment of cases that can be thus benefited.

1. Of the Nervous System.—In neuralgia:—Arcachon (for the calm, sedative, yet tonic atmosphere of the pine-woods), Cannes (the districts away from the sea), Upper Egypt (Cairo, Luxor, Helwan), Hastings, Hyères, the Engadine, the Bernese Oberland, Pau, Pisa, Rome, the Salzkammergut (Ischl, Aussee, Berchtesgaden). Some of the above climates will also be found suitable to cases of hemicrania and sciatica.

In hysteria, hypochondriasis, spinal irritation, and in some cases of protracted chorea:—Cannes, Ischl, Aussee, Meran, Mentone, Montpellier, Morocco (Tangiers), Nice, Naples, the Bernese Oberland (Grindelwald, Mürren), Palermo, Pau, Seville, Spezia, and Valencia; the effect produced being chiefly due to diversion of the attention by the change of scene, although the bracing influence exerted on the system at large must be taken into account.

In chronic softening of the brain and spinal cord, in paralysis of cerebral origin, and in some cases of locomotor ataxy, the South of France may be advantageously ordered in winter, and Alpine climates of moderate height in summer. As a rule hot climates, or those where the sun has considerable power, are contra-indicated where there is a tendency to apoplexy or hyperæmia of the brain.

Temperate and bracing climates are, as a rule, to be recommended in nervous diseases, to restore the general tone of the system.

The immediate neighbourhood of the sea not infrequently causes nervous excitement, neuralgia, and sleeplessness.

2. Of the Respiratory and Circulatory Systems.—In chronic bronchitis, emphysema, bronchial and spasmodic asthma, as well as in chronic pharyngeal and laryngeal catarrh and laryngeal ulceration, the following climates may be recommended:—Africa (South), Algiers, Australia, the Azores, Bordighera, Bournemouth, the Canaries, Upper Egypt, Glengariff, Hastings, Hyères, Lisbon, Madeira, Malaga, Mentone, Meran, Montreux, Nervi, Nice, Palermo, Pau, Penzance, Pisa, Queenstown, Rome, San Remo, Santa Barbara, St. Leonards, Torquay, and Ventnor.

Change of climate is of great value in convalescence from the acute, and as a prophylactic and curative measure in the chronic forms of bronchitis; but we must remember that where there is copious expectoration a dry climate is indicated, while in the irritative forms with scanty sputa (*bronchitis sicca*) a moderately moist mild climate is generally suitable. In emphysema we should choose a mild and not too dry climate, if possible in the neighbourhood of pine-woods, such as Arcachon on the west coast of France, or Bournemouth. In spasmodic asthma the choice of climate must be partly a matter of personal experience.

In the early active, and in the quiescent forms of the later stages of phthisis, as well as in chronic pleurisy, and in convalescence from pneumonia, the following (chiefly winter) health resorts and climates have been favourably spoken of, and many of them will be found described in this work under their own or associated headings:—Africa (South), Algiers, Australia, Bordighera, Bournemouth, Canaries, Cannes, Colorado Springs, Denver, Davos, Upper Egypt, Upper Engadine, South of France, Falmouth, Hastings, Hyères, Queenstown, Ischl (in summer), Madeira, Malaga, Mentone, Natal, Nervi, Nice, the Oberland (in summer), Palermo, Pau, Pisa, St. Paul's in Minnesota, San Remo, Santa Fé, Sicily, Spezia, Torquay, and the Undercliff (Isle of Wight).

In chronic endocarditis, pericarditis, and in heart-disease generally, a rather bracing climate, without extremes and of the character suited to chronic bronchitis, is usually indicated. Here both the tonic effects of climatic change, and the prevention of pulmonary complications, and fresh rheumatic attacks, must be taken into account. Mountain resorts of *moderate* height, well-protected from sudden changes of temperature, may be prescribed in summer.

In the neuroses of the heart, including (1) angina pectoris, (2) palpitation associated with chlorosis, hysteria, or hypochondriasis, and (3) exophthalmic goître, moderately bracing climates are indicated. In angina pectoris long journeys involving fatigue or exertion must be rigorously forbidden, as must also sightseeing or exciting amusements.

3. Of the Abdominal Organs.—In the various forms of chronic dyspepsia and intestinal catarrh, in chronic hepatic disease, in chronic dysentery (after removal from a malarial district or tropical climate), in diabetes, and in chronic endometritis, pelvic cellulitis, and other diseases of the uterus and its surroundings, the following climates may be selected from:—Cannes, the Engadine, Hastings, Hyères, Lisbon, Malta, Mentone, Montpellier, Morocco, Naples, Nice, the Nile, the Bernese Oberland, Pontresina, the Pyrenees (in summer), Queenstown, Schwalbach, Seville, Spezia, St. Moritz, Valencia, and Ventnor.

In convalescence from acute nephritis, and in all forms of chronic Bright's disease, but especially *catarrhal* nephritis, warm dry climates are indicated. Among the best are Upper Egypt, the Riviera, the Cape of Good Hope (inland), Bombay; and, in England, Brighton, Folkestone, Hastings, and Ventnor.

In renal calculus, removal from particular districts in which stone is known to be prevalent may possibly be of use in some cases.

4. Of the System at large.—Change of climate is here nearly always indicated:—

(1) In convalescence from typhus and typhoid fevers, scarlet fever (at the end of the desquamative stage), measles, diphtheria, and acute rheumatism; also in the third stage of protracted whooping-cough.

(2) As a prophylactic against all infectious diseases, and especially cholera, yellow fever, hay fever, influenza. and malaria; also against rheumatism and phthisis by withdrawal from damp districts, and goître and cretinism by removal from the *ensemble* of conditions to which the latter are due.

(3) In rickets, scrofula, chlorosis, general anæmia, and functional debility. Here, where a pure air and a bracing sunny atmosphere are the chief indications, the climates enumerated in section 1 are suitable; as are also Algiers, Biarritz (in autumn), the Cape of Good Hope, Ischl, Malaga, Rome, Sicily, St. Moritz; and, in Great Britain, a number of inland and seaside places (Malvern. Scarborough, &c.) which it is unnecessary to mention.

Edward I. Sparks. M. Charteris.

CLINICAL (κλίνη, a bed).—This word literally signifies 'of or belonging to a bed'; but it has been especially applied to the practical study and teaching of disease at the bedside; and has more recently been extended to all that relates to the practical study of disease in the living subject generally.

CLONIC (κλόνος, tumultuous movement). This word is applied to spasmodic movements which are of short duration, and alternate with periods of relaxation. *See* Convulsions; and Spasm.

CLONUS (κλόνος, tumultuous movement). The term now applied to tho movement of a portion of a limb by striking or forcibly stretching one of its tendons. *See* Spinal Cord, Diseases of; § 5. Spinal Reflexes.

CLOT.—A clot, or coagulum, is the product of the formation of fibrin (*see* Blood, Morbid Conditions of). Coagulation of the blood within the blood-vessels is described under Thrombosis; the coagulation of extravasated blood under Hæmorrhage, and Brain, Hæmorrhage into; and the coagulation of inflammatory exudations under Inflammation.

CLOTHING.—*See* Disease, Causes of; and Health, Personal.

COAGULUM (*coagulo*, I curdle).—*See* Clot.

COAL GAS, Poisoning by.—Coal gas, so largely employed for illuminating purposes, is a compound containing—in addition to olefiant gas and analogous hydrocarbons, on which the luminosity principally depends—certain so-called diluents, which burn with a non-luminous flame, namely, hydrogen, marsh-gas, and carbonic oxide, along with what are termed impurities, of which the chief are carbonic acid, sulphuretted hydrogen, and bisulphide of carbon. On these impurities the characteristic odour mainly depends. This odour, which is perceptible even to the extent of 1 in 10,000, is a valuable safeguard against accidents from escape of gas. The recently introduced water gas, made by decomposing aqueous vapour over burning coke, while it is more dangerous—only 1 per cent. being necessary to produce a fatal result—has not even this safeguard, for it is quite odourless.

A mixture of coal gas with the air inhaled exerts a deleterious effect on the system, and proves fatal when it reaches a certain percentage. In addition to the danger from inhalation, fatal accidents frequently occur from the explosive nature of the compound which is formed when the gas reaches the proportion of 1 to 10 of the atmosphere. Much less than this, however (a non-explosive mixture, therefore), proves fatal if long inhaled.

It is difficult to determine the exact proportion of the gas present in atmospheres in which fatal accidents have occurred, but we derive important information on this point from experiments on animals. Many such have been made. M. Tourdes, who has carefully investigated the subject, finds that pure gas is almost instantaneously fatal; $\frac{1}{8}$th kills rabbits in five minutes, and dogs in twelve minutes; $\frac{1}{15}$th kills rabbits in from ten to fifteen minutes; $\frac{1}{30}$th still proves fatal after a longer period; and evident signs of distress are caused in rabbits by an atmosphere containing only $\frac{1}{50}$th of the gas. Dr. Taylor (*Edin. Med. Journ.*, July 1874) has estimated the proportion of gas existing in a room in which a fatal case occurred at three per cent.

Sources of Poisoning.—Poisoning by coal gas is only known of as an accident. Occasionally suddenly fatal consequences ensue among workmen from exposure to a sudden rush of undiluted gas from gasometers and mains. More commonly slowly fatal cases result from the gas tap in a bedroom being left open carelessly, from accidental extinction of the light, or from leakage of gas-pipes in a house or at a distance. The gas gains access to the house in the latter case through cellars, walls, and more especially by means of drains and sewer-pipes, most commonly during winter and severe frosts, presumably from the ground surface being frozen and preventing escape into the streets. After passing underground, coal gas loses its odour, which is such a safeguard, most of the carburetted hydrogen and marsh gas is absorbed, and the amount of carbonic oxide is increased.

Symptoms.—Gas, even when in comparatively small proportion and just sufficient to cause an unpleasant odour, acts deleteriously if long breathed, and gives rise to headache and general depression of health. A very slight escape of coal gas—just sufficient to produce a close smell, not like that of gas, and therefore not recognisable as such—will cause relaxed or ulcerated throat, probably from the irritation of the sulphur compounds.

In severe and fatal cases the symptoms which have been noted are headache; nausea or vomiting; vertigo; and loss of consciousness, passing into deep coma and muscular prostration, which resembles the apoplectic state, the individual lying insensible and incapable of being roused, with livid features, stertorous breathing, and froth at the mouth. Death usually occurs quietly, in this state of coma, but occasionally with convulsions.

The state of the pupils does not seem to be constant, though they are generally dilated before death.

In Dr. Taylor's case (*sup. cit.*) the teeth were firmly clenched, and the eyes were in a constant state of lateral oscillation.

Fatal Period.—The fatal period of poisoning by coal gas is extremely variable, and a remittent character of the symptoms sometimes gives rise to fallacious hopes of recovery in cases which ultimately prove fatal.

Diagnosis.—The smell of gas in the clothes, breath, and perspiration, which continues for a considerable time after removal from the polluted atmosphere, is the best indication of the cause of the coma.

Anatomical Characters.—The smell of gas is often very marked. M. Tourdes found the blood as a rule dark, but in some recent cases it has been noted as being of a bright red colour. Other signs are: a bright coloration of the pulmonary tissue; froth in the air-passages; congestion of the mucous membrane at the base of the tongue, the mucous membrane of the trachea being in some cases a bright rose colour; engorgement of the cerebral and spinal venous system; and rose-coloured patches on the thighs.

Mode of Action.—It is obviously impossible to differentiate between the effects of the various constituents of coal gas, but we have good reason for believing that the most active agent is the carbonic oxide, which exists in the proportion of from five per cent. (English gas) to twenty-five per cent. The active agent is the same in water gas, which contains forty-four per cent. of carbonic oxide.

The symptoms in the main agree with those caused by carbonic oxide (*see* Carbonic Oxide, Poisoning by), and the effects, therefore, would be chiefly due to the action of the carbonic oxide on hæmoglobin. The blood of one patient after sixty hours gave the spectrum of CO-hæmoglobin, and Grehaut calculates that 100 c.c. of blood from an animal poisoned with gas give 20 c.c. of CO.

Treatment.—Instant removal from the polluted atmosphere is the first thing to be attended to. Attempts must then be made to cause oxygenation of the blood, by artificial respiration and excitation of the respiratory centres, by reflex stimulation of the face, chest, &c. Pure oxygen gas may be administered. As, however, the compound which carbonic oxide makes with the blood colouring-matter is a very stable one, and not easily broken up by the introduction of atmospheric air or oxygen, it not infrequently happens that these measures prove of no avail. In such cases it would be highly advisable to perform venesection, and then transfuse fresh blood, a plan of treatment which has been found successful in poisoning by carbonic oxide.

D. Ferrier.

COARCTATION (*coarcto*, I straiten). A pressing together, narrowing, or stricture of any hollow tube, such as the aorta, intestine, or urethra.

COCCYGODYNIA (κόκκυξ, the cuckoo; and ὀδύνη, pain).—SYNON.: Fr. *Coccygodynie*; Ger. *Steissbeinschmerz*.

DESCRIPTION.—This name has been given to a peculiarly severe and obstinate neuralgic pain in the neighbourhood of the coccyx, incited by such actions as defæcation, walking, sitting down, or rising from a recumbent position. It may arise from injury, such as fracture or luxation or horse exercise; or it may be the result of inflammatory affections of the sacro-coccygeal joint or of the pericoccygeal fibrous structures. Coccygodinia is also a concomitant symptom of many rectal, vulval, vaginal, and uterine disorders, being excited whenever any of the muscles which have their insertion in or near to the coccyx are brought into play. It not infrequently is a sequela to a difficult instrumental parturition, or may be a neurosal condition associated with gout or rheumatism.

TREATMENT.—In cases where the affection is primary, recourse must be had to rest in the lateral posture, anodyne suppositories of extract of belladonna and opium, and to the careful regulation of the bowels. If the pain be very severe, a local hypodermic injection of morphine may have to be administered. To be successful in our treatment we must, however, always endeavour to differentiate by means of a carefully conducted systematic examination the cause or causes which may be at work, and to attend to the proper indications. Tenotomy and excision of the coccyx have not proved to be uniformly successful, and should therefore only be had recourse to in specially selected cases. Attention must be paid particularly to the nervous system, and the general nutritive processes improved by the administration of arsenic, quinine, and iron. JOHN HAROLD.

COLD, A.—A popular name for Catarrh. *See* CATARRH.

COLD, Ætiology of.—*See* DISEASE, Causes of.

COLD, Effects of Severe or Extreme.—INTRODUCTORY.—The *general effect* of exposure to severe or extreme cold is to lower, even to extinction, all vital activity. The blood-vessels, especially the smaller arteries and capillaries, after a brief period of congestion, become contracted, the latter to such an extent as no longer to permit the passage of the red corpuscles; the normal condition, composition, and structural integrity of the various tissues are more or less impaired, or altogether destroyed; the red corpuscles become first crenated and later disorganised and broken up, the watery elements of the blood thicken, and when frozen become more or less separated from the saline and other constituents; and those processes of chemical and physiological change which are essential to every manifestation of life, being only possible within certain very narrow limits of temperature, are hindered or absolutely prevented.

The more *special effects* vary in degree and kind:—1st, with the degree of cold, the duration of the exposure, and the medium or manner of application; 2nd, with the part, and extent of surface exposed; and, 3rd, with the general constitution and physiological condition of the sufferer.

Moderate cold, acting during a short time, or even severe cold during a still shorter time, followed by the glow of speedy reaction, exercises a tonic and stimulating influence. If, however, the cold is very severe, or the exposure too long, the glow of reaction does not occur, but a sense of depression is experienced, from which, at best, recovery takes place but slowly. Continued exposure to such a degree of cold as is yet not incompatible with the maintenance of life, nevertheless keeps at low ebb activity of nutrition and function alike. Extreme cold and long exposure lead to congelation and consolidation of the various tissues of the body. After complete congelation of the body recovery is impossible.

Dry cold is much less readily injurious in its influence than cold associated with wet. The better conductor of heat the medium is, the more speedily and completely does it reduce the temperature of the part with which it is in contact. Immersion in water cools more rapidly than exposure to air of the same temperature; and contact with wool, wood, or metal, of the same degree of coldness, excites in each case a different sensation, and leads to a different result, or to similar result but with very different rapidity. Constant renewal of the medium in contact hastens the cooling effect; and a continuous draught of only moderately cold air may do more to chill than temporary exposure to an intensely cold but still atmosphere. If some external part, and a comparatively small extent of surface only, be acted upon, the effect may be simply local, and the general disturbance of the system scarcely appreciable. But if the whole body, or a considerable extent of surface, or any important internal organs be acted upon, a proportionately serious general effect is produced.

The young (infants especially) and the aged alike ill sustain exposure to cold, and are most liable to suffer, not only from its direct effects, but also from the various maladies to which it gives rise. The feeble, ill-nourished, and broken in health, especially the subjects of organic disease, or of degeneration due to habitual intemperance, readily succumb, or only slowly and imperfectly recover. Among the healthy and otherwise vigorous, hunger, fatigue, sleep, anxiety of mind, fear, and mental depression of whatever kind, lower—too often even to fatal issue—the power of resistance to the deadly influence of cold.

LOCAL EFFECTS.—For local effects of exposure to cold, *see* CHILBLAIN; FROST-BITE; and GANGRENE.

GENERAL EFFECTS.—The general effects and symptoms produced by exposure to severe or extreme cold vary in different cases. Temporary exposure produces, first, a sense of coldness or chilliness, associated with paleness and corrugation of the skin (the so-called *cutis anserina*), then shivering and tingling sensations, followed by numbness and diminution of muscular activity and power. Healthy reaction restores more or less quickly the normal condition. Prolonged exposure to extreme cold gives rise to a series of symptoms, graphically described by Beaupré somewhat as follows:—Reaction has a limit, and a moment arrives when the powers are exhausted. Shiverings, puckerings, paleness and coldness of the skin, livid spots, muscular flutterings, are symptoms of the shock given to the vital forces; syncope approaches; the stiff muscles contract irregularly; the body bends and shrinks; the limbs are half-bent; lassitude and languor invite to repose; a feeling of weight and numbness retards the steps; the knees bend; the sufferer sinks down or falls; the propensity to sleep becomes irresistible; everything grows strange; the senses are confused; the mind grows dull, the ideas incoherent, and the speech stammering or raving; respiration, at first interrupted, becomes slow; the heart's action is feeble, quick, hard, irregular, and sometimes painful, and the pulse progressively smaller; the pupils dilate; the brain becomes stupefied; and finally deep coma indicates the approach of inevitable death.

Other and somewhat different effects and symptoms, attributable to differences of circumstances and condition, have been from time to time observed. Distressing and almost intolerable thirst, with loss of appetite for food, is often experienced; and the attempt to obtain relief, by sucking snow or ice, only adds to the suffering. Somnolence is by no means so constant an effect as is commonly supposed—at any rate, in the earlier stages, and less extreme cases. On the other hand, inability to sleep has proved a common cause of suffering and consequent loss of strength. The manifestations of brain-disturbance due to exposure to cold, varying as they do from dulness, incoherence, wandering, and thickness of speech, to even raving delirium, are especially worthy of note, inasmuch as they resemble, and are liable to be mistaken for, the effects of alcoholic intoxication.

Death from the direct and immediate effects of cold is rare in the British Islands; but it is estimated that in the Russian Empire, on an average, 694 deaths occur annually from this cause. The length of time during which exposure can be sustained varies greatly with the condition of the individual and with surrounding circumstances, as well as with the degree of cold. Under ordinary circumstances, an hour's exposure to intense cold, without due protection against the loss of natural heat, often suffices to determine a fatal result. At the same time, well-authenticated cases are on record, in which persons buried, for days even, in snow, have nevertheless survived and ultimately recovered with little permanent damage.

MODE OF DEATH.—The immediate cause or mode of death occurring directly from exposure to cold seems in some cases to be principally shock; in some, syncope; in some, apoplexy; in others, asphyxia; and in others, again, coma. In most cases it is probable that these several conditions, with others less readily specified, combine to produce the fatal result.

ANATOMICAL CHARACTERS.—The appearances presented on *post-mortem* examination are somewhat differently described and estimated by different observers; but none of them are absolutely pathognomonic, and some are as likely to be produced by exposure of the body after death as during the process of extinction of life. Among the more noteworthy are the following:—strong cadaveric rigidity; paleness or waxy whiteness of skin, with patches of more or less bright redness about the face, neck, and limbs, especially on exposed or prominent parts; a contracted and shrunken condition of the male genital organs; comparative bloodlessness of superficial and external parts; accumulation of blood in and about the thoracic and abdominal viscera; great distension of all the cavities of the heart, with more or less clotted and often bright-coloured blood; the blood in other parts also sometimes of brighter colour than usually seen on *post-mortem* inspection; hyperæmia and congestion of the lungs; hyperæmia of the brain, overfulness of the sinuses, and excess of serous fluid in the ventricles, and at the base, in some cases; in others, comparative bloodlessness of the surface of the brain, and no distension of the sinuses; excessive fulness of the urinary bladder; and, lastly, separation of the cranial bones along the coronal and sagittal sutures. The lines of reddish or brownish staining along the course of the superficial blood-vessels, relied on by some as pathognomonic, are certainly not so, inasmuch as they depend upon exosmosis of the blood colouring-matter set free by disruption of the corpuscles, which may be effected by freezing after death, as well as before.

TREATMENT.—The treatment of sufferers from the effects of cold consists in the restoration of warmth, and the rekindling of those processes by which the natural heat of the body is maintained. But this must be done gradually, and with great care. As in the treatment of a frost-bitten part, so in the treatment of the body generally—all sudden or rapid elevation of temperature must be avoided. The sufferer, divested of the clothing previously worn, and wrapped in blankets, should be placed in the recumbent position in a room, the air of which is dry, still, and cold, but capable of being gradually warmed. Gentle but continuous friction should be made over the trunk and limbs, care being taken that rigid or frozen parts be not damaged by rough manipulation. At first, ice or ice-cold water may be used; afterwards dry rubbing with flannel or with the hands is better; later still some stimulating liniment may be employed. Some recommend immersion of the body in a bath of cold—at first ice-cold—water, the temperature of which can be gradually raised. This method would seem easy and advantageous, if means are at command. When the sufferer can swallow, warm, gently stimulating drinks—as tea, coffee, aromatic infusions, beef-tea, or soup—may be given, at first without, but later with some wine or spirit. Alcohol, though useless or injurious if taken to fortify against cold, is useful and beneficial when judiciously administered as a restorative after exposure. In all cases of insensibility, and even apparent death from cold, every effort must be made to restore animation; and the attempt must be persevered in for a considerable time before being given up as hopeless. It is often difficult, sometimes impossible, to judge whether life is absolutely extinct or not. And while, on the one hand, it is important that the temperature be not raised too quickly, lest reaction should be too strong or dangerously irregular; on the other hand, it is equally if not more important that the needful measures be adopted without delay, and carried out not too slowly, lest the chance of revival should be lost. In the less severe cases, restoration of warmth may be comparatively quickly accomplished. The state of the bladder should always be examined, and relief afforded, if needful, by aid of the catheter. Attention to the general health is often requisite for long after recovery from the more immediate effects of exposure has taken place. Rest, good nourishment, and tonics are indicated.

Cold as a Cause of Disease.—As a predisposing and exciting cause of disease, cold proves, in the British Islands, year by year, more fatal in its effects probably than any other single condition or influence. Any considerable fall in the thermometer below the average standard during the colder months of the year is constantly followed by a corresponding rise in the death-rate, and an increase in still greater proportion in the amount and extent of sickness and suffering. The Reports of the Registrar-General clearly prove this, so far as the death-rate is concerned. A striking instance may be quoted. In the week ending December 19, 1863, in the London district, 1,291 deaths were registered. Severe frost set in, and in the week ending January 9, 1864, the number rose to 1,798. The week following, ending January 16, no fewer than 2,427 deaths were registered. This enormous increase could be attributed to no other cause than the effects of the severe cold which prevailed. The Registrar-General also shows that after the age of from twenty to forty the mortality from cold increases in something like a definite ratio with increasing years.

General depression of the vital powers, congestion and functional derangement of various internal organs—the lungs, liver, and kidneys—catarrhal and other forms of inflammation of the mucous membranes, especially of the respiratory tract, but also of the intestinal canal and bladder, paralysis from central or peripheral lesion, together with rheumatism, chilblain, frost-bite, and gangrene, constitute the list of maladies most commonly caused and fostered by exposure to the influence of cold.

ARTHUR E. DURHAM.

COLD, Therapeutics of.

COLD, Therapeutics of.—The therapeutic uses of cold are various and extensive. Cold may be applied as moist cold, by means of wet compresses and cold lotions or baths; and it may also be used as dry cold in the form of ice enclosed in a receptacle of metal or india-rubber, or as a current of iced water circulating through a soft metal coil, as in Leiter's tubes. The flat coil of tube can be pressed to fit any part of the body. Each of these methods has its special advantages and adaptations. Furthermore, cold may be made use of by the mouth, and by injection into the mucous canals of the body.

GENERAL PRINCIPLES.—The general effects of cold, however applied, are to lower temperature, to diminish sensibility and fluidity, to contract the tissues and vessels, and so to reduce the volume of parts. The cold bath and cold sponging alike have the effect of lowering the temperature of the body. The fall of temperature sometimes is but transient, reaction setting in and heat of surface returning when the body is withdrawn from the cooling medium. At other times the temperature continues to fall after the individual is removed from the bath. If the action of the cold bath be prolonged, then a thermometer, introduced within the rectum, shows a great depression of temperature, and much pain is experienced, similar to the severe pain which is felt in the hand and arm when the former is held for some time in water at a temperature of 41° F., and which soon compels the withdrawal of the hand from the vessel. Cold baths and their uses are treated of in another article (*see* BATHS), but attention may here be drawn to the practice of cold sponging over the surface as an efficacious means of lowering preternatural heat and relieving acridity and dryness of the skin during fever. The addition of enough solution of potassium permanganate to give a slight purple tinge to the water, makes it especially refreshing to the patient. Reduction of hyperpyrexia by means of cold is now a well-established therapeutic method. *See* FEVER; and TEMPERATURE.

METHODS OF APPLICATION AND USES.—There are several methods of applying cold therapeutically:—

1. **Cold Affusion and Wet Packing.** In the practice of cold affusion, introduced by Dr. Currie, in 1797, the patient is unclothed, seated in a tub, and four or five gallons of cold water thrown over him. Thus, Dr. Currie said, a commencing fever might be 'extinguished.' In cases where the skin was burning hot and dry, it was observed that after the cold affusion temperature fell, perspiration broke out, and the patient usually dropped into a refreshing sleep. If the body-heat did not exceed 98·4° F., or if the patient was damp and chilly, with or without delirium, the cold affusion was regarded as dangerous and by all means to be avoided. Drs. Strauss and Hirtz speak most highly of the marvellous effect of cold affusion in cases of collapse during fever. This kind of collapse appears due to a paralysis of the nervous centres: the heart's action fails, as does also the respiration; but while the surface of the body is cold, the temperature, taken in the rectum, still remains abnormally high. The affusion is applied by pouring a pitcherful of water, at a temperature of, or a little above, 10° C. (50° F.), over the patient seated in a bath or on a waterproof cloth. The patient, plunged in stupor, is suddenly roused by the shock; he draws a long breath; the respiration becomes fuller; the cardiac ataxy ceases, and the pulse, which, traced by the sphygmograph during the collapse, presented a scarcely broken horizontal line, now regains its normal line of ascension; heat of surface returns, and the temperature in the rectum falls. The action of the cold affusion, as thus applied, is to excite immediate and energetic reflex action.

In many nervous affections, such as maniacal delirium, chorea, and hysteria, cold douches, shower baths, and affusions are valuable as restorative and curative agents. In the convulsions of robust children, a stream of cold water directed over the head from a height of two or three feet often has a speedily beneficial effect. Cold affusion has been tried in tetanus, but it has in some instances killed the patient (Elliotson).

Other cases in which cold affusions are of service are those where respiration fails, and it is necessary to appeal powerfully to the reflex excitability of the nervous centres. To resuscitate those who are in danger of death from a narcotic such as chloroform or opium, slapping the patient severely with a cold wet towel is an efficient method. In sunstroke, cold affusion over the head and neck may be resorted to, provided the skin be not cold and clammy, and the patient in a syncopal state. In conditions of nervous spasm—of the larynx, for example—cold douches over the neck may prove useful. Cold affusion to the feet was much commended by Cullen as a means of promoting action of the bowels in cases of obstinate constipation. Spasmodic retention of urine has been relieved by a cold douche over the perineum and thighs (Currie); and Mr. Erichsen mentions the case of an old man who found his power of micturition increased by sitting on the cold marble top of his commode. In cases of extreme debility, with damp, cool skin, low muttering delirium, and very feeble pulse, cold affusions are dangerous.

In some cases of fever, where for any cause a cold bath is objectionable, the patient may be wrapped in a wet sheet and then covered with a few blankets. The sheet as it becomes heated may be changed for one fresh and cold, or very cold water may be squeezed from a sponge over the sheet as the patient lies rolled up in it on a waterproof cloth. Allowing fragments of ice slowly to melt on the sheet which covers the patient is, in the author's experience, a successful way of treating the hyperpyrexia of acute rheumatism. In scarlet fever of malignant type, where the rash does not readily appear, this form of cooling pack has been found most valuable. The late Dr. Hillier and Dr. Gee have both added their testimony to its utility. In Dr. Gee's cases the patient remained packed in the wet sheet for one hour and was then removed to bed. The cases best suited for treatment by the wet pack are those where the skin is very dry and hot, and the patient exceedingly restless and delirious.

2. **Cold Compresses, Ice-Bags, Irrigations, Lotions, and Injections.**—Cold may be continuously applied with a view to abating undue heat of a *part* of the body. Iced-water rags or *compresses* may be placed over an inflamed throat, or on the head in inflammation of the brain. A narrow bladder of ice laid over each carotid artery in the neck is an excellent way of cooling the blood as it flows to the brain. In acute pneumonia Niemeyer has commended strongly the use of cloths dipped in cold water, well wrung, and then applied so as to cover the chest, and especially the affected side. These compresses are repeated every five minutes. Pain and dyspnœa are much relieved; sometimes the temperature falls an entire degree; and if the cold appliances do not arrest the actual attack of pneumonia, they may shorten its duration and promote convalescence. The necessity of so often having to change the compress, and thus disturb the patient,

is a great objection to this mode of applying cold. Dr. Lees, in the *Lancet*, Nov. 2, 1889, records several instances of arrest of the pyrexial process in pneumonia by means of a bag of ice applied over the inflamed lung. The development of broncho-pneumonia in children may be cut short by the ice-bag. A frozen compress over the cæcum is useful to stay peristalsis and check hæmorrhage in typhoid fever.

A powerful sedative and antiphlogistic effect of cold can be obtained by *irrigation*; *i.e.* allowing cold water to fall drop by drop on a cloth, so as to keep it continually wet with fresh supplies of water. This may be done by suspending over the part to be irrigated a bottle of water, in which a few pieces of ice may be put; one end of a skein of cotton, well wetted, is then allowed to hang in the water, while the other end is brought over the side of the bottle. This, acting as a syphon, causes a continual dropping upon the part to be irrigated. In injuries of joints, where it is of much consequence to check inflammation, this process, which abstracts heat gradually and without disturbance of the part, is most valuable. Irrigation of the shaven scalp in cases of meningitis is a very powerful cooling and sedative appliance, requiring care and watchfulness. A cap of india-rubber or coil of tubing over the head and back of neck, so arranged that a current of cooled water may flow continuously through it, will act as a general reducer of temperature. Where pounded ice is applied to the head in a bladder, this should be suspended by a string from the bedstead, so that the head of the patient may not have to sustain the weight of the bag and its contents. Five ounces of sal ammoniac and five ounces of nitre in a pint of water will form a frigorific mixture, which can be applied in a bladder when ice is not at hand. The ice-bag, and cold-water compresses renewed every three minutes, have been used as an appliance to strangulated hernia, and to prolapsed rectum, to reduce the volume of the part and so facilitate reduction. Care must be taken that the cold application be not continued so long as to cause gangrene. Cold wet compresses should not be applied over dry bandages, with which wounded or broken parts are secured. Several cases are recorded where a hand or arm has become gangrenous, in consequence of having been bound up with dry bandages, and then treated with cold-water compresses. The dry bandages, as they become wet, contract tightly on the limb and stop the circulation.

A mixture made of spirit of wine and water, or of eau de Cologne and water, is a simple form of *cooling lotion*. The spirit evaporates and so carries off heat from the surface. 1 fl. oz. of rectified spirit to 15 of water makes a good spirit lotion, and the addition of 4 drachms of nitrate of potassium, or chloride of ammonium, will add to its cooling and sedative effect. 4 drachms of the chloride of ammonium with half a fluid ounce of diluted acetic acid, and the same quantity of rectified spirit, in 15 fl. oz. of camphor water, is another form for a very serviceable lotion. These lotions, applied by means of a piece of soft rag or lint over the skin, act as refrigerants, cooling the head when it is hot or painful; reducing heat and arterial excitement in tumours or contusions; and tending in the latter to promote the absorption of effused blood. A lotion of 1 part alcohol and 3 parts camphor water, at a temperature of 75° to 85° F., was highly praised by Scudamore in cases of gout. Cold water, and cold lotions of vinegar and water, are familiar means for stopping hæmorrhage.

In cases of severe uterine hæmorrhage, *injections* of ice-cold water into the vagina, or into the rectum, frequently succeed in checking the bleeding. If the cold injection fail, hot water (110°-120° F.) may be tried in its place. In cases of bleeding internal piles, an injection of cold water, after the action of the bowels, braces the parts and constringes the bleeding vessels. Iced water has been used as antipyretic enemata.

3. **Dry Cold. Uses of Ice.**—Heat may be continuously abstracted from an inflamed part in a safe way, and without undue risk, by applying dry cold by means of a waterproof bag of vulcanised india-rubber filled with ice, snow, or a freezing mixture made of equal parts of salt, nitrate of potassium, and chloride of ammonium. Moisture from the air will condense on the exterior of the cold bag, but a piece of lint interposed will protect the skin from damp. The india-rubber is a bad conductor, and too great abstraction of heat need not be feared. The walls of an animal bladder conduct heat much better than the india-rubber, and it is necessary to watch carefully over the application of ice-bladders, for when continuously applied they have been known to cause severe frost-bite of the part. If, when cold is being applied, the patient persists in complaining of severe pain, it is right to examine carefully and see how the part is affected by the cold. Professor Esmarch, in cases of fracture, and in various forms of traumatic inflammation, has applied ice for periods of twenty or thirty days with the best results. In cases of commencing disease of the vertebræ this surgeon has used cold water placed in a tin vessel, so made as to adapt itself to the part to be treated. Minor cases of bruise with inflammation may be treated by cold employed in the form of a common bottle filled with cold water and kept pressed against the part. After operations upon the eye, the extraction of cataract for example, a small ice-bag is very useful in relieving pain and keeping down inflammation. For the same purpose an ice-

bag is sometimes applied to the chest after the operation of paracentesis.

Ice-bags placed along the course of the spine have been found effectual remedies in many forms of nervous disorder. In cases of epilepsy, where the circulation is sluggish, the hands and feet being always clammy and cold, an india-rubber bag of ice applied along the spine has been found to restore warmth, at the same time relieving headache and symptoms of incipient paralysis. Cold to the spine is asserted by Dr. Chapman to lessen the excito-motor power of the cord. In the severe pain of an inflamed ovary or testicle ice in a bag may often be employed beneficially as an anodyne. The long-continued application of bags of ice to the chest, for the arrest of hæmorrhage from the lungs, has been observed by Sir Richard Quain and others to be very apt to cause bronchitis.

Lumps of ice swallowed are invaluable in arresting hæmorrhage from the throat and stomach. In tonsillitis and diphtheria this same treatment tends to reduce inflammation and cool the throat of the patient. Obstinate vomiting can often be checked by swallowing fragments of ice.

4. **Cold as an Anæsthetic.** — Dr. James Arnott, in 1849, brought forward the use of a freezing mixture of ice and salt as a means of producing local anæsthesia, by freezing the part to which the mixture was applied either in a bag or in a metallic spoon. For small superficial operations this method of anæsthesia by congelation answers very well. The part becomes white and hardened to the cut of the surgeon's knife, there is very little hæmorrhage, and the wound made usually heals well by primary adhesion.

Subsequently Dr. Richardson indicated a very convenient way of inducing local anæsthesia, by the volatilisation of ether in the form of spray, by means of the hand-ball spray atomiser. Ether sprayed on the bulb of a thermometer, held about an inch from the jet, brought down the mercury to within 10° of zero F. When the jet was turned on to the skin, a marked degree of local anæsthesia was produced, but not enough for surgical purposes. By driving over the ether under atmospheric pressure, instead of trusting simply to capillary action —or to suction, as in Siegle's apparatus—one may bring the thermometer to 4° below zero within thirty seconds. By the use of this apparatus, at any season or temperature, the surgeon can produce cold even 6° below zero; and by directing the spray upon a half-inch test-tube containing water, he can produce a column of ice in two minutes. For local anæsthesia by cold, the ether spray answers well. Such operations as the removal of small tumours, opening abscesses, and inserting sutures may be painlessly performed.

John C. Thorowgood.

COLIC (κῶλον, the large intestine). — Originally colic signified a painful affection due to spasm of the bowel, but, though still retaining this application, it has now come to be further associated with other complaints which are attended with severe pain of a spasmodic character, a qualifying adjective indicating the nature and seat of each particular form. Thus *renal colic* is applied to the group of symptoms due to the passage of a stone from the kidney to the bladder; *hepatic colic* to those accompanying the escape of a gall-stone. *See* Colic, Intestinal.

COLIC, INTESTINAL.—Synon.: Fr. *Colique*; Ger. *Die Kolik*.

Definition.—Painful and irregular contraction of the muscular fibres of the intestines, without fever.

Ætiology.—*Predisposing causes.*—These include the nervous (as hysteria and hypochondriasis), lymphatic, and bilious temperaments; sedentary occupations; the female sex; and the period of youth or adult age. *Exciting causes.*—These may be grouped as follows:— 1. Irritation—from lodgment of gas due to fermentation of undigested food, and decomposition of fæces long retained within the large intestine; from fæces, or intestinal concretions, undigested or partly digested food, such as pork, shell-fish, salt meats, unripe fruit, or septic game; from cold drinks or ices; from excessive or morbid secretions, especially bile; from gall-stones; or from worms—a bundle of round-worms or coiled up tape-worms. 2. Morbid states of the bowel, including obstruction from intussusception, twisting, strangulation, &c.; ulceration (typhoid, tubercular, dysenteric); inflammation (enteritis, typhlitis, &c.) 3. Reflex nervous disturbance, due to anxiety, fright, anger, or other emotional disorder; to disease of the ovaries or uterus; to calculus (hepatic or renal); to dentition; or to exposure, especially of the feet and abdomen, to cold. 4. Blood-poisoning, as from lead, copper, gout, rheumatism.

Symptoms.—The characteristic or essential symptom of intestinal colic is pain in the abdomen, without febrile disturbance. It usually begins, and is most severe, in the umbilical region, then spreads to other parts, or to the whole abdomen, and is apt to travel from one part to another. It is almost always relieved by firm pressure, and by expulsion of flatus; and is paroxysmal in character, remitting, or exacerbating, or completely subsiding at intervals. The suffering is usually severe, often agonising, and to relieve it the patient bends forwards, pressing the abdomen firmly with his hands or against some hard surface, or rolls about. As a rule the abdomen is distended by flatus; in lead-colic it is, however, firmly retracted towards the spine, and the movements of the inflated intestines affected by spasmodic contraction, producing loud borborygmi, may frequently be seen and may be felt by the hand applied to the abdomen. The muscles of the abdominal wall and the bladder usually participate in the internal spasm: the abdomen becomes rigid or knotted, and the recti muscles become contracted into round balls, while frequently the navel is retracted; micturition is frequent or suppressed. Usually there is constipation, and the pain disappears when the bowels are freely relieved; sometimes, however, it persists for a time. Constipation stands in a twofold relation to colic, either as cause or as effect of the spasm.

The countenance expresses great suffering, anxiety, and depression, and the features may be pinched. The surface of the body is cold, especially the feet, and the pale skin is covered by a cold perspiration. The pulse is commonly of normal frequency, or is infrequent and feeble.

The symptoms vary somewhat with the cause. When due to irritating ingesta, the prominent symptoms are vomiting and diarrhœa, sometimes ending in catarrhal dysentery. In children the legs are drawn up upon the abdomen; the bowels are often at first confined; and the evacuations are greenish, offensive, and very acid, afterwards becoming loose.

In nervous and hypochondriacal subjects, and especially females, severe pain in the intestines, resembling that of spasmodic colic, is apt to occur (*see* ENTERALGIA). Flatulence plays a varying part in different cases; it is often a prominent symptom, and the form of colic thus characterised has been termed Colica flatulenta.

Vomiting is generally in proportion to the severity of spasm and the degree of intestinal obstruction.

DURATION.—The duration of the attack varies greatly, from a few minutes to several days. The spasm usually ceases abruptly, leaving a feeling of soreness in the abdomen, while there is enjoyable relief from suffering. Colic, when violent or intractable, may terminate in enteritis, in peritonitis, and—especially with children—in intussusception.

DIAGNOSIS.—A pain moving from place to place, relieved by firm pressure and unattended by fever, separates colic from other affections, more particularly from those due to inflammation, in which pain is always aggravated by pressure.

Distension with spasm of the stomach may be distinguished from a similar condition of the colon, by the pain occupying a higher position in the abdomen (at or around the ensiform cartilage instead of—as in colic—the umbilical or hypochondriac regions), and by the percussion note elicited being deeper-toned and more prolonged than that which is produced by a distended colon. Besides, in colic the spasmodic contraction of the colon, producing borborygmi, may be traced by the hand, or may be even seen, and there is tenesmus.

It should be borne in mind that enteritis or peritonitis may follow colic, when the pulse may become frequent, hard, and small, or frequent and soft, the temperature increased, and the seat of inflammation becomes tender.

PROGNOSIS.—Colic almost always ends in recovery, preceded by free evacuation of the bowels. Unfavourable signs are those arising from inflammation or intestinal obstruction.

TREATMENT.—In the first place the ætiological indications should be met. The irritating contents of the bowels should be dislodged by purgatives combined with sedatives, such as calomel (five or eight grains) or rhubarb (twenty grains), with opium (one grain), followed by repeated doses of some saline aperient, such as sulphate of magnesium or potassium, with tincture of belladonna, henbane or opium, and spirit of chloroform, until free action of the bowels is obtained.

A suppository containing half a grain each of hydrochlorate of morphine and extract of belladonna, or a subcutaneous injection of morphine, may secure immediate relief from pain before aperients have time to act. Large warm enemata often relieve quickly. Other suitable measures are—the warm bath, friction with warm oil or stimulating liniments, hot-water fomentations, steamed flannels, mustard or turpentine stupes, flannel bags containing hot chamomile flowers or heated sand, the stomach-warmer filled with hot water, and large linseed and mustard poultices. The diet should be liquid.

In the prophylactic treatment the diet should be strictly regulated; lodgment of irritating solids and gases within the bowels should be prevented (*see* CONSTIPATION; FLATULENCE; and STOOLS); and the abdomen and feet should be kept warm by a flannel roller or belt and thick woollen stockings, or by a foot warmer. GEORGE OLIVER.

COLLAPSE.—DEFINITION.—Collapse is a condition of nervous prostration. When it is extreme, the vital nervous functions are in a state of partial, sometimes nearly complete, abeyance. It may terminate in death, or be followed by gradual reaction and complete recovery.

Collapse and shock have usually been classed together, but it is not accurate to do so. It is true that the ganglionic centres of the medulla oblongata are more or less profoundly involved in both, and that the two conditions possess many symptoms in common, dependent upon the derangement of function of one or more of these centres. Some confusion is attributable to the fact that shock is a term applied not only to a state or morbid condition, but to the cause which most frequently produces that condition—a violent impression or 'shock' to the nervous centres (*see* SHOCK). Collapse arises from many different causes, shock being one, of which collapse may be regarded as a final and extreme degree, and into which it often imperceptibly passes. Collapse may occur under conditions where there has been no antecedent state of shock. Collapse presupposes previous nervous exhaustion, while shock may instantly appear in a healthy individual.

Ætiology.—Any severe injury, especially if attended by profuse and sudden hæmorrhage, may terminate in collapse, such, for instance, as the rupture of one of the abdominal viscera, a penetrating wound of the chest or abdomen, or a wound of the heart or of a large artery. Extensive burns or scalds frequently give rise to typical collapse; and severe and prolonged pain is capable of causing it. Rupture of the heart or of an internal aneurysm, if the patient do not immediately die, causes extreme collapse. Certain poisons, as tobacco and arsenic, will also produce this condition. It is an advanced stage of some diseases, as, for instance, of Asiatic cholera; severe drastic purgation also, or prolonged vomiting, from whatever cause, may occasion it. The pernicious malarious fevers and yellow fever often end in collapse. In acute yellow atrophy of the liver symptoms of severe nervous disturbance, resulting in a species of collapse, sometimes suddenly supervene. Pyæmia, septicæmia, prolonged narcosis, frequently terminate in collapse.

Symptoms.—The severity of collapse depends on the nature of the cause, and on the age and physical and mental vigour of the individual. It may vary from a moderate to an extreme degree. A moderate amount is seen in the course of fevers and some other diseases, but this neither modifies the progress of the malady nor attracts the notice of the patient, causing chiefly peripheral coldness. From this trifling amount collapse may pass to the most intense form, where the patient scarcely differs in outward semblance from a dead body. A superficial inspection will fail to detect the existence of the functions of respiration and circulation. Vitality may be said to have reached its minimum. In well-marked collapse from severe injury or loss of blood, the pulse at the wrist may be almost or wholly imperceptible; the heart's action scarcely audible, or very rapid, fluttering, and irregular; the surface of the body, the face especially, is deadly pale and cold, and the skin moist with clammy sweat; the respirations are very feeble, slow, and irregular, accompanied by sighing or gasping inspirations at intervals; the expression and character of the face are lost; the features are sunken and relaxed; the eyes are dull, glassy, staring, or languidly rolling about, and the conjunctivæ perhaps insensible to the touch; the nostrils are dilated; the sensibility of the whole body is diminished; and the muscular debility is extreme. The patient lies on his back, without a trace of voluntary effort. If a limb is lifted it falls back again as if dead. Yet the consciousness and senses may in many cases be almost unimpaired; if roused by repeated questions, the sufferer will with visible effort make a coherent though, probably, inadequate reply.

If relief be not given, the respirations may become slower and slower till each one appears the last, when a sudden sigh shows that life is still present; finally the pulse and heart's action become more and more faint, and death results from pure asthenia. A condition closely resembling traumatic collapse is often witnessed in the last stage of cholera, when in an extreme degree the patient almost resembles a corpse save for the convulsive movements induced from time to time by the painful cramps. The surface is pale or bluish and covered with profuse sweat, but is at the same time cold to the touch. The hands and extremities are icy cold; the tongue is cold, and so also is the breath, which is gasping and paroxysmal; no pulse can be felt at the wrist; the eyes and features are sunken; the mind is apathetic, but nevertheless the consciousness may be perfect, and the patient able to respond to questions with a strong voice. Severe purging and tobacco-poisoning produce a condition very like that described as traumatic collapse.

Some cases of malignant fever terminate in collapse, which is characterised by extreme anxiety, by pallor or lividity of the face and surface, coldness of the skin, sweating, and a small, frequent, and irregular pulse.

A decrease of animal heat, especially in the external parts, is characteristic of collapse. The temperature of the internal organs varies; and there may be collapse with high internal temperature. This occurs in cholera, intense fevers, and some forms of septicæmia; or the converse may obtain, as is frequently witnessed in the collapse of dissolution. Collapse from loss of blood differs from syncope, although the latter may be described as an acute and transient form of collapse. In syncope the prominent symptom is loss of consciousness, which in collapse may be almost or quite perfect.

For the Pathology and Treatment of collapse, *see* Shock.

William Mac Cormac.

COLLAPSE, Pulmonary.—A condition in which the lung is simply more or less devoid of air. *See* Lung, Collapse of.

COLLIQUATIVE (*colliqueo*, I melt). A term which originated in the belief that in certain conditions the solid parts of the body melted away, and were carried off as *liquid* discharges. The word is now generally applied to the copious sweats and diarrhœa which occur in certain wasting diseases, such as phthisis.

COLLOID (κόλλα, glue; and εἶδος, like). A peculiar morbid product resembling in its characters glue or jelly, and found associated with cancer and other forms of new-growth. *See* CANCER; and DEGENERATION.

COLON, Diseases of.—SYNON.: Fr. *Maladies du Colon*; Ger. *Dickdarmkrankheiten.*—The colon participates to a varying extent in the lesions and derangements of dysentery, typhoid fever, enteritis, peritonitis, and other affections. The special disorders to which it is most liable are intimately connected with its anatomical and physiological peculiarities. The colon is a distensible membranous tube, of large capacity, with chiefly solid contents, which are propelled slowly onwards by the muscular contractions of the walls. The moving force and the resistance offered to it are often too finely balanced, so that whenever the energy of the former is somewhat reduced, an accumulation of excretory products is apt to be determined. Hence arise retention of fæces and gases, constipation, and consecutive evils, such as colic, colo-enteritis, or ulceration of the colon.

I. **Atony and Dilatation.**—DEFINITION. Loss of contractility of the walls of the colon, leading to accumulations, dilatation, and other sequelæ.

ÆTIOLOGY.—The causes of torpor or atony of the colon are mainly those of constipation—sedentary, indolent, and luxurious habits, over-stimulation of the bowels by coarse foods, purgatives, and enemata, a sluggish and lymphatic temperament, old age, and general debility or exhaustion, as after a long and tedious illness (*see* CONSTIPATION). Whenever the walls of the colon are distended by solid or gaseous accumulations, the contractile power is apt to be enfeebled, leading to further retention, loss of tone, and dilatation.

Atony of the colon is an important element in the pathogeny of constipation. The colon is apt to become greatly dilated throughout, or mainly so in certain portions, such as the cæcum and sigmoid flexure, behind some cause of obstruction—stricture, misplacement, elongated meso-colon, lodgment of fæces, &c.; but instances of even excessive dilatation are recorded without the *post-mortem* discovery of a mechanical cause. When, however, dilatation results from obstruction, there will be found hypertrophy of the muscular coat of the bowel. Tympanitic distension of the colon from paralysis of the sympathetic occurs in peritonitis and in certain fevers, such as typhoid.

SYMPTOMS.—Torpor of the colon may be indicated only by constipation. There are usually the ordinary signs of retention of flatus or fæces. In hysteria, and in inflammation of the bowels or peritoneum, flatus is apt to accumulate rapidly, and to produce great distension of the colon. Fæces may collect and form large tumours in any part of the large intestines, but especially in the cæcum and sigmoid flexure. *See* STOOLS.

Fæcal and gaseous accumulations in the colon resulting from atony may produce the following effects, directly or remotely connected with them:—

(*a*) *Local.*—1. Colic. 2. Inflammation of the walls of the colon, or of the mucous and submucous coats, and ulceration. 3. Disturbances from pressure. Thus flatulent distension and fæcal accumulation encroaching on the cavity of the thorax, and impeding the descent of the diaphragm, may cause feeble respiration, dyspnœa or short and rapid respiration, palpitation and irregular action of the heart or upward displacement of this organ, with remote effects arising from a disturbed circulation in the brain, such as giddiness and headache. On the other hand, a distended cæcum or sigmoid flexure, pressing on veins and nerves, may induce œdema, numbness, and cramps of the right or left lower extremity. 4. Retarded digestion, derangement of the stomach and liver, and intestinal obstruction.

(*b*) *General.*—The absorption of excrementitious matters may lead to widespread general effects, indicated by a sallow, earthy, or dirty complexion, lassitude, debility, offensive breath, loaded urine, and other symptoms. Chlorosis has been attributed to this cause.

TREATMENT.—Atony of the colon is usually a chronic disorder demanding prolonged treatment. The hygienic and dietetic rules laid down in the article CONSTIPATION require in most cases to be supplemented by medicines. The most satisfactory results follow a course of tonics combined with aperients, such as iron, quinine, strychnine, and belladonna, with aloes, colocynth, or rhubarb. The purgative should be adjusted to each case, so as to secure no more and no less than a regular and efficient evacuation; and while the loaded colon continues to be thus relieved, the dose should be very gradually reduced. This tonic-aperient course may be greatly aided by local stimulation of the colon, as by massage, electricity, and cold-water compresses or abdominal douches (*see* CONSTIPATION). The abdomen should be supported by a belt or roller. Bretonneau and Trousseau strongly advised a course of belladonna, giving gr. $\frac{1}{7}$ of the extract, or of the powdered leaf, as a pill in the early morning—the stomach being empty; then two such pills, if in four or five days the bowels do not respond; and increasing the dose, but not beyond that contained in four or five pills in twenty-four hours. A teaspoonful of castor oil may be given twice a week to aid this course of treatment. Flatulent distension of the colon in the elderly, and in females at the climacteric period, is often greatly relieved by the prolonged use of a pill containing the compound asafœtida pill and extract of nux vomica, after meals.

In excessive gaseous dilatation of the colon (as in volvulus of the sigmoid flexure), producing much distress from dyspnœa, pain, and vomiting, puncture by a fine trochar or aspirator-needle has been successfully resorted to as a palliative measure.

II. Stricture.—Stricture of the colon may occur in any part, but is most common in the sigmoid flexure and descending colon. It is limited to adults. It more commonly arises from cancer than from the cicatrising of an ulcer (simple stenosis). In non-cancerous stricture a history of dysentery is important—though a long interval (even years) may have elapsed since the attack. The stricture declares itself by setting up symptoms of intestinal obstruction—there being at varying intervals attacks of paroxysmal, shifting, colicky pain across the navel, with constipation (or constipation alternating with diarrhœa) aggravated by purgatives, becoming more and more frequent and associated with vomiting—when, as a rule, the difficulty ceases to be intermittent. Large fæcal masses may often be felt above the site of obstruction. In stenosis of the sigmoid flexure there is sometimes tenesmus, and the motions are flattened; the stricture can be reached when the whole hand is introduced into the rectum. The motions are not, as a rule, altered in shape when the stricture is situate in the higher part of the colon. The site of obstruction may sometimes be determined by auscultating the abdomen while water is being gently and intermittently injected into the rectum—the observer failing to hear the stream above the stricture. The duration of the cancerous as well as of the simple forms averages from five to six months.

Treatment.—The treatment of stricture of the colon is further referred to in the article on Intestinal Obstruction.

III. Inflammation.—Synon.: Colitis; Colonitis; Colo-enteritis; Fr. *Colite*; Ger. *Entzündung der Schleimhaut des Kolons.*

An inflammation, leading to ulceration of the mucous membrane and submucous connective tissue of the colon, producing lesions indistinguishable from those of dysentery, has been pointed out by Copland and Parkes. Colitis is said to be a non-specific local affection, commencing in the submucous tissue, and subsequently attacking the mucous membrane with its glandular structures—the primary seat of dysenteric inflammation. As in dysentery, the inflammation induces gangrenous destruction and ulceration of the mucous membrane and underlying cellular tissue.

A *catarrhal* form of colitis is apt to occur in measles. 'It often happens that the morbillous catarrh of the intestines exhausts itself by attacking the large intestine, producing that special form of colitis characterised by tenesmus and glairy bloody stools.'[1] Inflammatory diarrhœa, particularly in children, often terminates similarly.

Colitis arising from *retained excreta* may involve the entire wall of a circumscribed portion of the colon, commonly the ascending colon and sigmoid flexure, or may be confined to the mucous and submucous tissues. In fæcal retention the mucous follicles of the colon may become obstructed, and the distension resulting therefrom may lead to inflammation and ulceration. Irritation of the mucous lining of the colon from the lodgment of fæces may extend to the lymphatic vessels and glands. The glandular enlargement cannot, however, as a rule, be recognised during life. In colitis there are usually colicky pains, intestinal distension, and diarrhœa alternating with constipation; and the stools are often coated with masses of mucus.

Treatment.—The treatment of colitis consists in the local application of fomentations, poultices, opium enemata, or morphine suppositories; and in the use of gentle laxatives, such as castor oil, combined with sedatives, such as opium, belladonna, or henbane. The catarrhal form generally terminates in spontaneous recovery. Trousseau advised the use of albuminous injections, or of injections containing about half an ounce of water and nitrate of silver—from $\frac{3}{4}$ to $1\frac{1}{2}$ grains; or sulphate of copper or sulphate of zinc—from $3\frac{1}{2}$ to $4\frac{1}{2}$ grains. The diet must be very carefully ordered.

IV. Displacements.—The parts of the colon most liable to displacement are the transverse colon and sigmoid flexure. The former may descend as low as the pubes; the latter may occupy any position between the left iliac region and the right side of the abdomen. Usually the mesocolon is elongated; there is adhesion between the displaced part and the new site; and, the longitudinal bands being elongated, the loculi are obliterated. Displacements are most apt to occur in those who have long suffered from constipation, retention of fæces, chronic dysentery, hernia, or from encysted or other tumours. They may lead to complete obstruction, and cannot usually be recognised with certainty during life.

V. Diverticula.—A loculus of the colon from repeated accumulation may become so distended as to form a lateral appendix. Such a diverticulum when loaded with fæces may be felt through the abdominal wall as a distinct tumour, which may collapse when pressed between the fingers.

George Oliver.

COLORADO SPRINGS, in Colorado, U.S.A.—A clear, cold, and very bracing climate, with great dryness and diathermancy of the atmosphere; 6,028 feet above the sea. No snow in any quantity, and consequently no snow-melting season. Dry and dusty winds in spring. Camping out at nearly all seasons tolerably safe. A high-altitude station, useful in asthenia and in chronic phthisis, especially with limited lesions and no pyrexia. The name of 'springs' is added from the proximity of Colorado City to Manitou Springs, six miles distant. *See* Climate, Treatment of Disease by.

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[1] Trousseau, *Clinique Médicale.*

COLOUR-BLINDNESS.—A defect of vision, the subject of which is unable to distinguish certain colours. *See* Vision, Disorders of.

COMA (κῶμα, deep sleep).—A condition of profound insensibility. *See* Consciousness, Disorders of.

COMA-VIGIL (κῶμα, deep sleep; and *vigil*, wakeful).

Definition.—A symptom, or set of symptoms, where continuous sleeplessness is associated with partial unconsciousness.

Coma-vigil occurs towards the end of diseases in which the nervous system is involved either directly or indirectly, especially where sleeplessness has been a symptom in the earlier part of the disease. Thus it frequently appears towards the end of an attack of typhus or of delirium tremens, when these are about to terminate fatally.

Symptoms.—The patient lies quiet with his eyes half-closed, inattentive to everything around, but not absolutely unconscious. If the eyelids are touched, they are closed, and perhaps the head is slowly turned away. The eyes have a dull, half-glazed look, and slowly follow any moving object near them. The pupils are neither much dilated nor contracted, and they move under the influence of light, but very sluggishly. The mouth is generally somewhat open and dry, as are also the lips. The power of swallowing is much impaired: if a small quantity of fluid be put into the mouth, an effort is made after a short time to swallow it, and this effort is for a time successful; but after the symptoms have been present for some time, the effort is so feeble that no result follows. The patient lies mostly on the back; if turned on the side, he either remains as placed, or often slowly turns to the former position. The limbs are occasionally moved a little; and if the hand or arm be raised, a slight resistance is offered. If the bladder or the rectum be emptied, there is slight consciousness of the act, as if a feeling of discomfort preceded it. The pulse is quick and weak. The respirations are weak, but otherwise normal. The symptoms continue unbroken throughout, nothing like natural sleep occurring.

Pathology.—As being little more than a symptom, coma-vigil has strictly speaking no pathology. It seems to coincide with the gradual suspension through exhaustion of the functions of the nervous centres; the cerebral hemispheres being nearly if not quite inactive, while the action of the rest of the centres is kept up weakly but continuously, till the little remaining nervous power is exhausted, when death ensues. It differs from coma inasmuch as in the latter the medulla oblongata is the only centre left active, the functions of the rest being entirely suspended. It differs from concussion, inasmuch as the symptoms of the latter attending the temporary unconsciousness are more those of irritation than of pure suspension of function.

Diagnosis.—Coma-vigil is distinguished from coma by the presence of a certain amount of consciousness, by the quick pulse, and by the absence of stertorous breathing. It is distinguished from concussion of the brain by the pupil not being contracted, by the history of the case, and by the absence of coldness of the skin, and of any sign of shock.

Prognosis.—The prognosis is unfavourable: coma-vigil is almost invariably a fatal symptom. It may last from a few hours to three or four days; from twenty-four to forty-eight hours being the most common duration. It may deepen into actual coma; but more usually the symptoms change but little, save that the pulse becomes quicker and weaker, and the respiration more feeble, and death by asthenia then results.

Treatment.—Coma-vigil does not call for treatment directly itself, but is an urgent indication for nutritive and stimulant measures calculated to relieve the primary disease.

R. Beveridge. John Banks.

COMEDONES (*comedo*, a glutton).—Synon.: Grubs.—This is the name applied to the little cylinders of sebaceous and epithelial substance which are apt to accumulate in the follicles of the skin, and to appear on the surface as small round black spots. When squeezed out they have the appearance of minute maggots or grubs with black heads, and thence have derived their name. They may occur in all parts of the body where sebaceous follicles exist, but are most common on the face, the nose, the neck and shoulders, the breast, and within the concha of the ears, in the latter situation often attaining a considerable size. The accumulation of this substance is due to want of expulsory power of the skin, and to the slight impediment which is afforded by the aperture of the follicle to its exit. When squeezed out, a comedo is found to vary in colour, in figure, and in density, according to the period of its detention. When recent, the comedones are soft and white, and modelled into an exact cylinder by compression through the mouth of the follicle. If impacted for a considerable time, they acquire the yellow tint, the transparency and hardness of horn; they assume a bulbous figure from the dilatation of the follicle below the constricted orifice of the epidermis; and by their bulk they sometimes stretch the hair-follicle so far as to obliterate it completely. Besides their usual composition of sebaceous substance and epithelial cells, they frequently contain lanuginous hairs, and not rarely the entozoon folliculorum in its different phases of development (*see* ACARUS). When they raise the pore into a minute pimple they have a similitude to acne punctata, and might be mistaken for that affection; whilst the black spot on the summit of conical acne is due to a comedo.

TREATMENT.—Comedones are most frequently met with in young persons in whom the powers of the constitution are not yet established, and who are benefited by generous diet and tonic treatment. Locally, soap and water with plentiful friction and ablution will be found of great service; and, as an astringent, a lotion of perchloride of mercury in emulsion of bitter almonds (two grains to an ounce) and spirits of wine; or a lotion of carbolic acid. ERASMUS WILSON.

COMPLICATION (*con*, with; and *plico*, I fold).—It is difficult to give a strict definition of what ought to be included under the term *complication*; but the word signifies the occurrence during the course of a disease of some other affection, or of some symptom or group of symptoms not usually observed, by which its progress is therefore 'complicated,' and not uncommonly more or less seriously modified. The difficulty lies in determining what should be looked upon as essentially part of the original disease, and what as a mere accidental occurrence. For instance, many regard the cardiac affections which so often arise during the progress of acute rheumatism as a part of the complaint, others as complications. The same remark applies to the relationship of renal disease to scarlatina, as well as to numerous other cases.

Complications arise in different ways. They may, as just indicated, be considered as developments of the original morbid condition, resulting from the same cause and being more or less allied; or they are independent and accidental, of which an illustration is to be found in the association of ague with scurvy or dysentery, or in the co-existence of two or more of the exanthemata. The most important class of complications, however, are those which follow the primary disease as more or less direct consequences. These may further be induced in various ways. Thus, for example, in febrile diseases secondary lesions are liable to arise as a result of changes in the blood; a mechanical act, such as cough, may lead to complications in the course of phthisis and other pulmonary affections; cardiac diseases frequently bring about consecutive changes in other organs, by inducing obstruction of the venous circulation; or emboli may originate under certain conditions and produce their usual consequences. It is of great practical importance to be acquainted with the complications which are liable to be met with in various diseases, and especially in those which are of an acute nature, in order that measures may be taken for their prevention, and that they may be recognised and treated at the earliest possible period, if they should occur.

FREDERICK T. ROBERTS.

COMPOUND GRANULAR CORPUSCLES.—Formerly these microscopic objects were regarded as of inflammatory origin, and as affording positive evidence of the occurrence of inflammation. Hence they were termed 'compound inflammation globules' (Gluge). Almost all pathologists now, however, recognise the fact that they are not products of an inflammatory process, but result either from the degeneration of pre-existing cells, in which protein and fatty granules accumulate, or, perhaps, from the aggregation of granules originally distinct, which are present in abundance in degenerating tissues. They may even be formed out of the cells of morbid products, such as cancer. These compound granular corpuscles derive their name from the fact that they consist of a large number of minute granules aggregated together, and they either present a delicate cell-wall, or this cannot be detected. Occasionally there is an appearance of a nucleus in the centre. *See* CELL. FREDERICK T. ROBERTS.

COMPRESS.—A compress is made of folds of lint or other material, and is used for the purpose of producing pressure, or as a pad by which hot or cold water or medicinal agents may be applied to the surface. In the latter case the compress may be rendered waterproof by being covered with a piece of gutta-percha tissue or mackintosh-cloth. *See* HYDROPATHY.

COMPRESSIBLE.—A term implying comparatively slight resistance, and applied specially to the pulse when it yields readily under the finger. *See* PULSE, The.

COMPRESSION of the Brain.—*See* BRAIN, Compression of.

COMPRESSION of the Lung.—*See* LUNGS, Compression of.

CONCRETION (*con*, together; and *cresco*, I grow).—SYNON.: Calculus; Fr. *Concrétion*; *Calcul*; Ger. *Concrement*.

DEFINITION.—An unorganised body, formed either in one of the natural cavities or canals, or in the substance of an organ, by the deposit of certain solid constituents of the fluids of the part. In the widest sense of the term, concretions comprehend calculi.

ENUMERATION AND CLASSIFICATION.—The following classified list includes the principal varieties of concretions:—

1. In *glandular structures*: lacrymal, salivary, pancreatic, prostatic, seminal, urinary, hepatic, sebaceous, and mammary.

2. In the *circulatory system*: cardiac, and venous (phleboliths).

3. In *closed sacs*: peritoneal, and articular.

4. In *culs-de-sac*: bronchial, pulmonary, nasal, tonsillar, laryngeal, gastric, intestinal, præputial, uterine, and vaginal.

5. In the *substance of tissues* and new formations, especially in the nervous system: corpora amylacea.

6. *Various*: such as the concretions on the teeth known as 'tartar.'

General Characters and Number.—Concretions are generally firm or even of stony hardness; but they may be soft and friable. Their colour varies from white to black through shades of yellow and red. Concretions occur either singly or in groups; and their shape and size, as well as the characters of their surface, vary considerably with their number: single concretions are more frequently larger, rounded, and less smooth than multiple specimens, which often present facets and polished surfaces. Many concretions are composed of concentric laminæ.

Composition.—The chief constituents of concretions are inorganic, that is, mineral salts, in a basis of organic matter. The bulk of the salts are carbonate and phosphate of calcium and magnesium, with smaller quantities of alkaline compounds. The organic basis is composed of albuminous substances, mucus, cholesterin, and colouring matters.

Mode of Formation.—Concretions are generally derived from the solid constituents of vital fluids, whether physiological or pathological. In most instances the fluids are delayed in the natural passages by some abnormal obstruction or dilatation; and under such circumstances a chronic inflammatory condition of the walls contributes greatly to the probability of mineral deposit. Most frequently—as in the formation of the salivary and biliary concretions—the fluid portions of the secretion escape by the natural outlet or are absorbed, while the solid constituents are deposited; the particles being either agglomerated around a nucleus, or deposited in centripetal layers upon the surface of the cavity. In other instances—intracardiac, peritoneal, and articular—a nucleus is furnished by a particle of fibrin, blood-clot, or growth, on which fresh deposits take place, while calcification proceeds in the interior. In a third series, examples of which are found in the alimentary canal, the basis of the concretion consists of foreign or indigestible matter, such as hair, a gall-stone, inspissated fæces, and masses of magnesium or iron salts. *See* Calculi.

Effects and Symptoms.—The functions of a part occupied by a concretion are generally more or less impaired; the neighbouring tissues frequently atrophy; and inflammation and ulceration are common results, ending probably in the escape of the body. The concretion may be passed along a duct, and this process is generally attended with great pain; but concretions may remain where formed without causing symptoms. Occasionally they are spontaneously disintegrated or dissolved.

Treatment.—The treatment of concretions will be found discussed under the heads of the diseases of the organs where they respectively occur.

J. Mitchell Bruce.

CONCUSSION (*concutio*, I shake together).—This term is used to indicate a condition induced by a more or less violent shaking or physical commotion of the general system, or of some particular organ, whereby serious symptoms may be induced, but no definite lesion can be detected to account for them. The nerve-centres are the parts most liable to be thus affected, concussion of the brain or spinal cord being of considerable moment, giving rise to more or less complete abolition of their functions, though this effect is usually only temporary (*see* Brain, Concussion of; and Spinal Cord, Diseases of). General concussion of the body is highly important at the present day, in connexion with railway accidents, after which persons seem to be uninjured, or only to be slightly shaken, but subsequently more or less grave symptoms, associated with the nervous system, set in. *See* Railway Accidents, Results of.

Frederick T. Roberts.

CONCUSSION OF BRAIN, SPINE, &c.—*See* Brain, Concussion of; and Spinal Cord, Diseases of.

CONDYLOMA (κονδύλωμα, a knob).—Synon.: Fr. *Condylome*; Ger. *Feigwarze.*

This vague term has been used to describe at least two different things—namely, (*a*) papillomata, or warty growths in the neighbourhood of the anus and genital organs; and (*b*) the syphilitic lesions called mucous patches or mucous tubercles. Of these the former only will be dealt with here. The latter are described under Mucous Patch.

Description. — Condylomata are commonly found in connexion with the constant moisture and irritation due to acrid secretions, whether natural or morbid, especially the discharges of venereal affections. The growths occur most frequently and attain the greatest size in dirty persons, in whom also they are most liable to become inflamed, ulcerated, and fissured. The enormous masses sometimes seen in pregnant women are often called 'cauliflower' growths.

Treatment.—Frequent washing, followed by the free application of some absorbent powder, such as oxide of zinc, is essential. When the growths are very large, or fail to disappear under caustics, removal by scissors, knife, or cautery will be necessary.

Arthur Cooper.

CONFLUENT (*confluo*, I run together). Applied chiefly to a variety of small-pox and other exanthemata, in which the eruption runs together or coalesces.

CONGENITAL (*con*, together; and *genitus*, begotten).—Existing at birth: a term generally applied to diseases such as *congenital syphilis*, or malformations such as of the heart, and *congenital clubfoot.*

CONGESTION (*congero*, I accumulate). Overfulness of vessels, caused by accumulation of their contents: generally applied to blood-vessels. *See* CIRCULATION, Disorders of.

CONIUM, Poisoning by.—SYNON.: Fr. *Empoisonnement par la Ciguë*; Ger. *Schierlingsvergiftung.*—All parts of the hemlock plant (*Conium maculatum*; Greek, *κώνειον*) are poisonous. Both the leaves and fruit are used in medicine. Its toxic properties were known in ancient times; the plant was used for the destruction of criminals by the ancient Greeks, and there is no doubt that Socrates was poisoned by it. Death from conium in this country has perhaps always been the result of misadventure or suicide; but on the Continent the active principle of the plant, *conine*, an alkaloid, has been administered for the purpose of wilful homicide, death resulting from a dose of 10 to 15 drops.

ANATOMICAL CHARACTERS.—The signs of asphyxia, engorgement of lungs and of the right heart, and a general venous condition of the blood, appear to be constant after death from conium. There is nothing else specially noticeable.

SYMPTOMS.—Preparations of conium, as well as the alkaloid, or mixture of alkaloids, known as *conine*, when taken in toxic doses, produce excessive muscular weakness, beginning in the lower limbs, and extending gradually upwards, with giddiness and disordered vision. These symptoms are in some cases preceded by nausea and vomiting, with dryness or burning pain in the mouth and fauces. There is a desire to remain quiet, and a peculiar heaviness or drooping of the eyelids, the patient lying with his eyes shut. This, and the impairment of vision, appear to be due to paralysis of the ocular muscles. The pupils may be natural, but later they become dilated. The pulse is slow till death is actually impending. The paralysis progresses gradually upwards, till eventually heart and respiration are affected, more especially the former. Convulsions and impairment of the mental faculties—hitherto intact—now set in; finally sensation is impaired, and death ensues from asphyxia.

DIAGNOSIS.—The paralysis of motion, progressing gradually upwards, with sensation long unimpaired, and the peculiar drooping of the eyelids, are perhaps diagnostic of the nature of the poison.

PROGNOSIS.—As no antidote is known which counteracts the effects of conine, the prognosis must always be a guarded one, and will depend entirely upon the general condition of the patient.

TREATMENT.—The stomach must be emptied by the stomach-pump or syphon-tube, and well washed out. Emetics may also be used to evacuate the stomach. Tannin and other astringents must be freely administered, to precipitate the active alkaloid, and prevent its absorption. Castor oil, administered by the mouth or rectum, may aid the removal of the alkaloid when it has been rendered insoluble by tannin. Strong coffee, brandy, ammonia, and stimulants generally are serviceable, as may also be the hypodermic injection of ether. Hypodermic injections of 1-40th grain of sulphate of atropine are very promising, especially in the later stages; atropine acting as a respiratory and cardiac stimulant. Artificial respiration, and stimulation of the respiratory and cardiac functions by the use of electricity, ought not to be neglected when these are affected.

THOMAS STEVENSON.

CONJUNCTIVITIS.—Inflammation of the conjunctiva. *See* EYE AND ITS APPENDAGES, Diseases of.

CONSCIOUSNESS, Disorders of.—The disorders of consciousness are so numerous as to make it desirable briefly to consider them in one article, with a view to their classification and the better comprehension of their mutual relations. We shall, therefore, here group and arrange the varied morbid conscious states, not aiming to produce a strictly scientific classification so much as one which will be practically useful.

1. **Exaltation.**—Under this head may be ranged certain states of consciousness more or less distinctly bordering upon the unnatural, to be met with in persons under the influence of 'mental excitement' from various causes, as from sudden good news, or generally pleasant surroundings; also from a slight degree of poisoning by alcohol, opium, hashisch, or other drugs; or from an early stage of some forms of insanity, or of delirium. In this state of mental exaltation the individual's powers of perception, apprehension, recollection, thought, emotion, and volition, would seem to be all more or less intensified, just as in that of hebetude or dementia they are diminished, and consciousness is proportionately dwarfed.

2. **Perversions.**—Many of the various defects here to be referred to are very partial in the extent to which they implicate consciousness, though others are general. In what is known as an *illusion* some object of sense is not correctly perceived; or, in other words, some sensorial impression is quite wrongly interpreted—as when a feverish or a maniacal patient, looking at some inanimate object, declares that it is a cat or a dog.

about to fly at him, or, hearing even the slightest noise in any part of his room, interprets it to be the voice of some friend or imagined enemy. In the case of an *hallucination*, however, forms are declared to be seen, or voices heard (by a patient suffering from delirium tremens, for instance), where no appreciable external realities could have started the notion. And in these cases, it is not that the patient sees or hears without believing; he implicitly believes that the visions or voices, which have been conjured up subjectively by the mere disordered working of his own brain, have a real existence in the outside world. It is necessary to make this distinction, because it is by no means uncommon, in regard to the olfactory sense (especially in some epileptics), for odours or smells to be perceived which the patient soon comes to know are purely subjective or devoid of any external correlative.

Hallucinations and illusions, moreover, though occasionally existing alone, are quite commonly associated with a very important and more general derangement of consciousness, namely, *delirium*. This is a symptom very common in many fevers, in certain low states of the system, after severe frights, in inflammatory or other lesions of the brain and its membranes, as a result of some narcotico-irritant poison, or occasionally in a person who is recovering from an epileptic attack, or from the stupor sequential to a series of convulsive attacks. The state itself varies much in intensity. Three fairly distinct types exist. In (*a*) *low* or *muttering* delirium the patient lies still and more or, less heedless of what is occurring around; or, if heeding at all, the impressions which he receives give rise to erroneous perceptions (illusions), which are woven into the incoherent fabric of his rambling thought. In (*b*) *delirium tremens* the patient is more restless; tremors of the limbs and of the muscles of the face are often easily induced; hallucinations of sight and hearing are common; and the character of the delirium reveals that the patient is, to an unusual extent, possessed by fears, terrors, and other emotions of a depressing type. In (*c*) *wild* or *raving* delirium we have to do with a much more active state. The patient raves loudly and incoherently, more in regard to his fleeting dream-like thoughts than in connexion with external impressions, of which he is more or less heedless. He is often violent in demeanour, and difficult to be restrained, persons in this state being capable of great and prolonged muscular exertion. The bodily activity accompanying this form of delirium is, in fact, just as characteristic as the great intensity of the mental processes. It is met with occasionally in some fevers, but more commonly in meningitis and in acute mania.

In its early stages delirium is principally noticed during the transition-period between waking and sleeping—at times, that is, when the nervous system most needs the reinvigorating influence of sleep. It is in these cases, too, that beef-tea or stimulants may for a time dispel all traces of the wandering thought. Whilst illusions and hallucinations enter largely into the mental activity of a delirious patient, *delusions* also are generally well-marked components. That is to say, the person becomes for a time possessed by an idea, notion, or fancy, for which there is no real warranty, though he believes and wishes to act as though it were true.

Somewhat allied to delirium in nature, though much lower in intensity as a mental process, is that *incoherence* of thought which is met with in many chronic maniacs, or in non-febrile patients suffering from various organic brain-diseases. In its slighter degrees this incoherence displays itself as mere 'rambling' talk; the patient has not sufficient brain-power to follow up the main subject of thought, and is frequently diverted into collateral channels. This, which is a natural state with some persons, may be distinctly indicative of disease in others whose mental power has previously been of a more vigorous type. At times the incoherence is seen to be governed principally by mere verbal suggestion, the patient being led away from point to point in new directions, owing to the associations of some word which has been used becoming for the time dominant. This state is often well seen in the sub-acute exacerbations of chronic mania, though it may occur also where multiple softenings or indurations of the brain exist. At other times the incoherence is more absolute—wayward transitions from subject to subject, connected by no discoverable bond, rapidly following one another. The result in such a case is a mere unmeaning jumble of words, interspersed here and there with brief propositions having a limited significance of their own, though often wholly unrelated to that which precedes or follows.

Hypochondriasis is a perverted state of consciousness, having some resemblance to that of illusion, but in which some internal or visceral state becomes the starting-point of impressions (possibly not actually painful) which, when magnified and perverted as they are in the mind of the patient, fill him with false and gloomy apprehensions of various kinds. This perversion of consciousness is more generalised than that which exists in the case of illusion; and also, instead of being a more or less temporary defect, it is one that may last for weeks, months, or even years. The state of mind of an hysterical patient is often not altogether different from that of the hypochondriac.

3. **Partial Loss.**—Defects of this order are numerous and may exist in great variety. They may implicate almost equally nearly all

the varieties of conscious mental activity, or some more than others. They may be either congenital, or acquired during the life of the individual.

In *idiocy* we may have from birth defect in the power of concentrating the attention, a defective power of apprehension and of thinking, and a defective volition, shown alike by an inability to guide or control thought, and by a deficient vigour of bodily movement. Again, as a result of epilepsy, of organic brain-disease, or of injuries to the head, the patient may gradually lapse into such a condition from one of health, so as to become, as it is termed, 'demented.' Whilst this state of *dementia* may supervene at any age, it is much more common as a consequence of the brain-diseases frequent in advanced life. There is, moreover, a form known as *senile dementia*, in which without any typical disease, but as a consequence of impaired tissue-vitality and diffused degenerative changes throughout the nervous system, the mental faculties undergo a more marked degradation than is usually met with in old age. This condition in its minor degrees goes by the name of *hebetude*. In all such states or grades of idiocy and dementia, we meet with an undue tendency to sleep in the daytime as a result of the listless and languid mental condition. This is but another sign of the general lowering of conscious vigour.

Here we must include, also, a peculiar group of conditions, having some alliance with one another, and which are all characterised by loss of consciousness to some extent, either partial in range or general. They are—*reveric*, *somnambulism*, *ecstasy*, *coma-vigil*, *catalepsy*, *hypnotism*, and *trance*. They are merely enumerated here, but are defined or described in their several places. In the last of these conditions the loss of consciousness, in the ordinary acceptation of the term (namely, loss of perceptive power), is so absolute, that some may think it ought rather to be included in the next section. Loss of perceptive power, however, would not seem to be absolutely synonymous with loss of consciousness. There is good reason to believe, for instance, that where the influence of chloroform and other anæsthetics is not pushed to the fullest extent, a condition of *anæsthesia* intermediate between slight and profound is produced, in which, whilst there is absolutely no consciousness for external impressions, so that pain is altogether unfelt, there is still a certain amount of cerebral activity—as evidenced by rambling and indistinct speech on subjects altogether apart from what the surgeon may be doing. There is mental activity clearly, though the nature of this, as revealed by the patient's speech, may preclude the notion that pain is at the time being felt. Sensorial consciousness is blotted out, whilst a kind of ideational consciousness remains. We have an approximation to such a condition, also, in the case of *sleep* when dreams are rife. But here sensorial consciousness is not completely in abeyance. Again, in certain rare and anomalous epileptiform attacks we may find the patients, after the first paroxysms, bereft of some senses, though not of others. They may hear what is said by those around them, though they continue for a time quite unable to see or speak.

4. **Complete Loss.**—In very profound sleep (*sopor*), in that prolonged form of it in which the person, if he can be momentarily roused, drops off again immediately (*lethargy*), and also in profound *anæsthesia*, there is complete loss of consciousness. The terms sopor and lethargy are now rarely used, and authors are not even agreed as to the precise state which would be designated by the latter word. It is sometimes regarded as a synonym for 'trance.'

In *syncope* we have insensibility resulting from a cutting off of the proper supply of blood to the brain; whilst in *asphyxia* we have a like result following upon an interference with respiration, and a consequent engorgement with impure blood.

A condition of *narcosis* or profound insensibility may result from opium or other drugs and poisons, amongst which alcohol is to be included as one of the most common producers of such a state. It may also be due to the deficient elimination of waste products by the kidneys, when 'uræmic coma' is produced; or to the abnormal production of chemical compounds in the system, which lead on to blood-poisoning, as in 'diabetic coma,' and in the final stages of septic poisoning.

Complete loss of consciousness exists for some time during the ordinary form of *epileptic fit*, or during an attack of convulsions; though in other epileptiform fits, not infrequently met with—having some of the characters of hysterical convulsions—there seems to be a loss of sensorial consciousness only (loss of perception), whilst a certain amount of ideational consciousness remains. In *apoplexy* also there may be for hours or days a more or less profound loss of consciousness. In the less profound attacks, as well as after an epileptic fit or an attack of convulsions, the loss of consciousness is not complete, and we have a condition now commonly known as *stupor*. This state is also frequent as a result of concussion or other injuries of the brain, and it occasionally follows a severe fit of hysterical convulsions. It may last for hours, days, or even weeks in some cases. In it the patient lies with his eyes closed, taking no heed of what is passing around, though he may show obvious signs of feeling when touched or pinched, and may be capable of being momentarily roused, so as to give a short monosyllabic answer if slightly shaken or spoken to in a loud voice.

On these occasions, signs of impatience are often shown. Though such a patient will not ask for food, he will often drink freely when it is offered. He will of his own accord, when his bladder is full, sometimes get out of bed, find the chamber-pot, use it, and return to bed without saying a word—and then speedily relapse into his previous state of stupor. When the insensibility is more profound, both urine and fæces are passed incontinently.

The state just spoken of is referred to in this section because it is so intimately allied to and connected by all sorts of transition conditions with another, known as *coma*, in which the loss of consciousness is more complete and absolute. There are different degrees of stupor and there are different degrees of coma; the former is commonly spoken of as slight or deep, whilst a comatose condition, coma, and profound coma (the latter being what the older writers termed *carus*) are the phrases ordinarily used to denote the increasing insensibility of the graver state, which is more especially characteristic of the apoplectic condition. Coma may result from long-continued exposure to cold, from sunstroke, from poisons of various kinds, from erysipelas of the head and face, from inflammations of the meninges, multiple embolisms, the effects of hyperpyrexia, or from cerebral hæmorrhage. The most common cause of very profound coma is cerebral hæmorrhage (apoplexy). In this condition the breathing is often loud and stertorous, and consciousness is entirely obliterated, so that there is an utter absence of reflex movements when a limb is pinched or when the conjunctiva is touched. The patient in the deeper forms of coma often cannot be roused at all, even for a moment; and if this state does not terminate in one way or another before the expiration of twenty-four hours, or if it does not gradually pass into one of mere stupor, a fatal result may be considered imminent.

H. Charlton Bastian.

CONSTIPATION (*con*, together; and *stipo*, I cram).—Definition.—Slow passage of the fæces from the cæcum to the anus, leading to infrequent or incomplete alvine evacuation, and to retention of fæces.

Ætiology.—The causes of constipation may be *local*—an impediment to the onward movement of the fæces in the large intestine or from the rectum; or *general*—pertaining to habits, diet, and other conditions.

Local.—The local causes of constipation include: (*a*) Lesions inducing narrowing of some part of the large intestine, as from cicatrising of an ulcer or displacement of the bowel. (*b*) Collections of scybala, intestinal concretions, &c., in the cæcum, sigmoid flexure, or rectum. Fæces are more especially apt to collect when too solid or when deficient in bile. (*c*) Pressure on the rectum, by uterine fibroids or ovarian tumours, uterine displacements, the gravid uterus, or an enlarged prostate. (*d*) Defæcation thwarted, as when the expiratory abdominal muscles are enfeebled, as in pregnancy—especially when repeated or after twins, obesity, old age, or in some painful affection of the abdomen, such as rheumatism of the abdominal walls and diaphragm, chronic dysentery, piles, fissure, or the evacuation of a hard mass of fæces. (*e*) Feeble contraction of the intestinal muscular fibres, as in distension of the large intestine or a portion of it by gas, fæces, or lumbrici, inflammatory affections (chronic intestinal catarrh, chronic peritonitis), lead-poisoning, senile atrophy, or in delicate females with lax muscular fibre (*see* Colon, Diseases of). (*f*) Pain in the pelvic viscera, and probably elsewhere, may induce paralysis of the sympathetic nerves supplied to the intestinal walls; thus may be explained obstinate constipation in painful uterine and ovarian diseases, which cannot be accounted for by pressure on the bowels or otherwise.

General.—The general causes of constipation are: (*a*) Sluggishness of function—lymphatic temperament, hereditary influence, anæmia, especially with amenorrhœa; or, on the other hand, disposition to great activity of the muscular and nervous system. (*b*) Certain habits, such as sedentariness; railway travelling—long journeys; too great muscular activity; mental application, especially when excessive or prolonged; the continued and *apparently* necessary use of aperients or enemata after the relief of temporary constipation—falling under the tyranny of aperients; habitual disregard of defæcation, or hurry in the act; prolonged hours of sleep; the excessive or even moderate use of alcohol, tea, tobacco, or opiates. (*c*) Dietetic errors: the diet too nutritious—leaving little intestinal residue, or poor and insufficient; improper feeding, especially in infants and children; and the use of indigestible substances, such as cheese, nuts, or uncooked vegetables.

Constipation is frequently a prominent symptom in diseases of the stomach; of the liver; of the heart, inducing congestion of the portal system; and of the nervous system: as well as in connexion with diabetes, excessive perspiration, prolonged lactation, and morbid discharges.

The causes of constipation are such as evidently induce one or both of the following conditions, namely, (1) dryness and hardness of the contents of the large intestine from deficient secretion, or too active absorption of fluid from the intestinal tract; and (2) impaired contraction of the muscular fibres of the large intestine.

Description.—In constipation the evacuations are infrequent, solid, deficient in quantity, and sometimes unusually offensive; they often consist of dry, hard, dark or clay-coloured masses or scybala. Defæcation is generally difficult or even painful. As a rule the depth of colour, and the scybalous character of the motions, are in proportion to the duration of the lodgment of fæces in the large intestine. Infrequency of defæcation regarded alone is an untrustworthy sign of constipation, or of constipation demanding medicinal or other treatment, inasmuch as it often depends on individual peculiarity. Good health may be consistent with departures from the ordinary rule—a daily evacuation; not infrequently there is no relief from the bowels for several days or even for a week, and yet without inconvenience, so long as the infrequent defæcation is habitual, or can be ascribed to idiosyncrasy.

The disturbances of function usually associated with constipation may be local, or may extend to distant parts.

The *immediate* or *local* effects are such as may arise from retention of fæces:—signs of fæcal collections in the cæcum, colon, sigmoid flexure, or rectum; irritation of portions of the intestine, indicated by colic, inflammation, dilatation, ulceration, and perforation of the intestines, followed by peritonitis; intestinal obstruction—a portion of the bowel loaded and distended with fæces being no longer capable of peristaltic movement; pressure of fæcal accumulations on the intrapelvic vessels and nerves, inducing menorrhagia, uterine catarrh, seminal emissions, varicocele, hæmorrhoids, cold feet, neuralgia, numbness and even œdema of the legs (*see* Fæces, Retention of). Constipation frequently exerts a pernicious influence on primary digestion, indicated by foul tongue, fœtid breath, anorexia, acidity, flatulence, biliary disturbance—even jaundice, and urine loaded with lithates.

The *remote* or *general* effects of constipation are lassitude of body and mind; headache, flushing, heat of head, and vertigo; palpitation; anæmia, and wasting. Headache and nausea depending on retention of fæces may be either pretty frequent without loaded tongue; or may recur with vomiting and much coating of tongue every three or more weeks—these periodical attacks resembling migraine, but always cleared up by an aperient.

Treatment.—Constipation depending on individual peculiarity is rarely relieved permanently by treatment. The bowels, having acquired from early life the habit of infrequent evacuation, may be stimulated for a time, and are then apt to become more sluggish than before. In all cases the habit of the patient in this respect from childhood should first be determined, either as a caution against active or prolonged treatment, which may prove injurious, or as a guide to the adjustment of directions and remedies—affording as it does a limit which should not be overstepped. A healthy daily discharge of fæces should not fall far short of five ounces, and should form a coherent cylindrical-shaped mass of five or six inches in length, which should float; and it is an essential condition of healthy and efficient defæcation that the colon should always be moderately full of retained fæces. The practitioner should bear in mind that many persons acquire the erroneous belief that they are not discharging a sufficiency of fæces, and in consequence betake themselves to aperients, which daily remove the normal residuum of fæces that should exist in the colon—healthy peristalsis and defæcation being thus out of question. This apparent constipation can only be met by completely suspending the use of aperients.

1. *Ætiological, hygienic, and dietetic treatment.* — In treating constipation the causes should be met. Local causes, such as those inducing contraction of or pressure on some part of the large intestine, or feeble or ineffectual contraction of the intestinal muscular fibres or of the expiratory muscles, should first be eliminated. When defæcation is obstructed by the sphincter ani either remaining firmly contracted, or failing to relax sufficiently, it may be effectually relieved by forcibly dilating the anus under ether. Habits disposing to constipation should also be corrected. Persons who are much preoccupied or careless are apt either to disregard the call to stool, or to perform the act of defæcation hurriedly, incompletely, and at irregular intervals. Such persons should be strictly enjoined to direct their attention, expectancy, and will to the attainment of complete and regular evacuation. The sensibility of the nerves of the rectum becomes blunted by the constant contact of fæces, and the promptings of nature at last cease. Hence the periodical removal of collections in the lower part of the large intestine is an essential element of the treatment. This is best secured if possible by well-timed and well-directed and sustained natural efforts. The patient should be told to attempt defæcation every day after breakfast, and to persevere in this habit even though the result be occasionally or frequently unsuccessful, and in order to develop his solicitation into the daily habit of evacuation he should continue to practise it always at the same hour, and should disregard any prompting that may arise at other times. While straining to relieve the bowels, he may facilitate evacuation by pressing firmly the fingers in front and on each side of the coccyx, thus supporting the levator ani during contraction, reducing the concavity of the rectal pouch, and causing the mass of fæces to glide forwards through the sphincter, which should be smeared with vaseline; or he may attain the same end by alternately contracting or relaxing the anal sphincter. Failing to obtain relief on the second day,

a small cold-water enema should be used to prevent further accumulation of fæces in the rectum, and to restore tone and sensibility to the blunted nerves. The enema should never be larger than is required to dislodge the motion from the pouch of the rectum, nor should it be warm; at first it may, however, be tepid, but should afterwards be cold. When evacuation is obstructed by the lower part of the fæcal mass becoming dry, relief may be obtained from a small emollient enema administered on rising (such as infusion of linseed, glycerine in small quantities, solution of white of eggs, olive oil alone or in oatmeal gruel) and allowed to remain until after breakfast; or by the use of suppositories at bedtime, consisting of cacao-butter, or honey hardened by heat, either alone or combined with extract of belladonna. The clothing should not constrict the abdomen or waist, and should be warm—especially about the feet and legs. Sedentary habits should be broken into. Exercise on foot or on horseback, or on a cycle, is especially to be commended, and carriage exercise to be avoided. While studying or reading, the patient should walk about, and stand rather than sit at the desk. Gymnastics and out-of-door games (such as lawn-tennis, cricket, football, golf) are useful when a limited time only can be devoted to exercise. Excessive and exhausting exertion should be avoided. It is generally advisable to recommend early rising and cold bathing, followed by brisk general towelling in the morning. In different cases one or other of the following may be found serviceable: a shower or sponge bath containing vinegar or bay-salt, or consisting of sea-water, or a cold sitz-bath; douches directed to the abdomen; a cold-water compress applied to the abdomen during the day or night, or for three or four hours in the morning; friction or kneading, or slapping with the half-closed fist in the course of the colon every morning, and when at stool; an abdominal belt (flannel or elastic)—especially if the abdomen be pendulous.

Diet.—The diet should be varied, should not consist too exclusively of animal food, but should contain a good proportion of fresh vegetables, and especially green vegetables (cabbage, lettuce, spinach). Fresh and ripe fruit (such as grapes, apples, and oranges) should also find a prominent place, and are most effective when taken in the early morning, or at breakfast. When fruit induces acidity a tumblerful of alkaline (Vichy or Vals) water should be taken at the same time. Oils and fats are generally serviceable when they do not disturb the digestion, such as the addition of a dessert-spoonful of olive oil to green vegetables or to potatoes. A tea-spoonful of glycerine with each meal is often helpful. The diet should not be too dry. As to beverages, much must be left to individual experience: sometimes coffee, or beer, or cider answers best. A tumblerful of cold water should be taken night and morning on awaking; sometimes carbonic-acid water in the early morning is found preferable to plain water. Coarse articles of food—such as bran- or wheatmeal bread, oatmeal porridge, &c.—are often commended, and now and then they do favour the continuance of more efficient evacuation; more frequently, however, they fail—especially after a time—and they then aggravate the evil by further adding to the undue collection of residue in the large bowel, and are apt to set up catarrhal irritation. Acidity and other symptoms of dyspepsia contra-indicate the use of these indigestible foods. Honey or treacle with bread, gingerbread, and Spanish or Portugal onions, plainly boiled, may be found useful in certain cases. Dujardin-Beaumetz recommends infusion of linseed (a little water let stand on a dessert-spoonful of linseed for an hour) immediately before a meal.[1] As a rule, eggs, milk, cheese, farinacea, astringent wines, and tea increase constipation; and besides these articles it is best to avoid pickles, salted meats, nuts, and pastry in any form.

2. *Treatment by massage and electricity.* Many observers in recent years have reported the complete cure of constipation by a course of massage alone. The manipulations consist of kneading (*pétrissage*), stroking (*effleurage*), and slapping (*tapotement*), each having its special effect: the first loosening impacted fæcal masses, the second favouring their passage along the bowel, and the third improving peristaltic action. In some instances the forms of massage best adapted to the case should be applied to the whole of the large bowel from the cæcum onwards; in others it should be addressed specially to certain portions, as the cæcum, transverse colon, or sigmoid flexure. Sometimes all the manipulations, in varying proportions and degrees, are required in succession, or only one or two kinds—for instance, in atony of the bowel depending on sedentary habits, gentle and then deep stroking should give place to strong slapping with the half-closed hand; and in cases marked by flabbiness of the abdominal muscles, the recti should be forcibly separated by the thumbs and fingers, and then strong transverse strokings from the median line should be made, and the patient should take deep inspirations to strengthen the diaphragm. Each case should therefore be treated with discrimination, and a routine method should be avoided. The massage should be applied for from twenty to thirty minutes every or every other morning, and should be continued without interruption for from five to eight weeks.[2] *Electricity,*

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[1] *L'Hygiène Alimentaire.*

[2] A rude form of massage has been suggested in the form of a cannon-ball, or other similar round metallic body, weighing 3 or 4 lbs., to be rolled up and down the uncovered abdomen for from five to ten minutes daily at the same hour, the patient being recumbent.

either alone or with massage, has also proved successful in certain cases; a mild galvanic (continuous) current being applied by inserting the negative pole well within the sphincter ani and drawing the positive pole along the colon, and the faradic (interrupted) current being passed through the abdominal muscles.

3. *Medicinal treatment.*—Should the foregoing directions fail to establish the habit of a regular action of the bowels—either daily or on alternate days, they may be supplemented by the prescription of medicinal agents, to compass the twofold aim of (1) relieving the large bowel of the excess of fæces and gases which, by over-distending it, opposes peristalsis, and (2) toning its walls. To this end care should be taken to so adjust the dose (for it varies considerably in different cases) as to secure if possible efficient assistance to the discharge of fæces, without going so far as to clear away or to considerably reduce the normal residuum which should always exist in the colon. If, therefore, any prescribed dose has exceeded this limit it should be reduced, and should not be given next day, but after the lapse of a day or two. Repeated purging exhausts torpid bowels, and perpetuates constipation. Nor should the bowels be pushed to more frequent relief than has been habitual with the patient from early life. If the evacuations habitually contain scybala, and fæces are generally found, on examination, in the rectum, the injection of a tea-spoonful of glycerine, or the insertion of a glycerine suppository, twenty minutes or so before the time of the desired evacuation, may alone suffice, or may enable a smaller dose of medicine to deal effectually with the difficulty. If gentle assistance only is required, and if griping and other signs of irritation are readily set up by the ordinary aperients, one or other of the following may be tried:—a tea-spoonful of castor oil alone, or with an equal part of glycerine, beaten together and then added to a table-spoonful or two of milk, or with olive oil or almond oil, at bedtime or in the early morning; the official sulphur lozenges (suggested by Sir Alfred Garrod) or tabloids at bedtime; rhubarb and dried carbonate of sodium (gr. ij. or iij. of each), or a small piece of rhubarb-root before the midday meal; pills of dried ox-gall and soap. Or, if a more decided laxative is necessary, a preference may be given to the compound liquorice powder, or confection of senna (with or without confection of sulphur or the compound sulphur tabloids), or the infusion of a few senna-pods in half a tumbler of water let stand over night, or extract of cascara sagrada. During late years cascara sagrada has acquired a high position as a tonic aperient, and is prescribed either in the form of solid extract (as in tabloids or pills, alone or variously combined), or in that of the liquid extract—the dose of the latter varying from ♏v. to ♏xxx. alone or associated with tincture of nux vomica, of belladonna, or of podophyllum, in a tea-spoonful of glycerine, or along with euonymin in capsules. Combinations on the lines of the favourite formula of Sir Andrew Clark also meet the indications well in the majority of cases (aloin, extract of nux vomica, extract of belladonna, sulphate of iron, powdered myrrh, powdered soap, of each half a grain; and, if the fæces are dry and hard and there is no special weakness of the heart, add powdered ipecacuanha half a grain). Some prefer a pill of Socotrine aloes with henbane and sulphate of iron and quinine. In a well-organised course of medicinal treatment the form of the aperient should be varied every now and then, and the dose very gradually reduced until at last it is almost withdrawn, while the intestinal tonics (belladonna, nux vomica, and iron) should be continued. The time when the dose should be taken is important, for it will vary—be it before lunch, or dinner, or at bedtime—with the slowness or quickness of the response of the bowels to the attainment of relief after breakfast. Bretonneau's treatment by belladonna, greatly prized by Trousseau, is described in the article Colon, Diseases of.

In anæmic cases a firm and prolonged course of iron should be aided by aloes, nux vomica, and arsenic. In hæmorrhoidal complications aloes should, as a rule, be avoided, and laxative electuaries should be prescribed; in some cases, however, it gives tone without irritating the rectum. In obstinate cases colocynth—either alone or variously combined—is most useful; such as the tincture of the Prussian Pharmacopœia, ♏v. or more on sugar or in extract of liquorice (to disguise the bitterness) three or four times a day, or 10 to 20 minims an hour before breakfast; or the extract or compound pill with small doses of croton oil, or with gamboge, elaterium, or other combinations. A full dose of opium may liberate the bowels after the failure of the strongest purgatives, and constipation depending on inhibition of the sympathetic nerve from pain will be relieved by opium with belladonna. When constipation is associated with a deficient flow of bile, cholagogues (such as an occasional mercurial, euonymin, or podophyllin) should be prescribed with the other remedies; and dried ox-bile in capsules or pills, and nitric acid or nitro-hydrochloric acid often prove useful. Sometimes enemata answer better than purgatives; then, when frequently required, they should be small in quantity, and at first tepid, afterwards cold; for occasional use, for the purpose of clearing away fæces loading the large bowel, they should be large (from two to six pints) and warm (*see* Fæces, Retention of). The frequent use of large warm injections perpetuates constipation. Purgative waters, such as the Rubinat, Friedrichshall, Pullna, Hunyadi János, or Carlsbad, given in warm water in the early morning or over night, are often valuable adjuncts to other treatment. A combination of the sulphates of iron, magnesium, and sodium with strychnine and belladonna, after food twice a day, is often efficacious; especially in the constipation of children; and in children under two years of age carbonate of magnesium (gr. v. to xx.) in milk is preferable to other aperients.

George Oliver.

CONSTITUTION.— Synon.: Diathesis; Habit; Conformation of Body; Fr. *Constitution*; Ger. *Leibesbeschaffenheit.*

The constitution may be *sound* or *unsound.* A sound constitution may be defined as the harmonious development and maintenance of the tissues and organs of which the body is made up. It originates with the union of a healthy sperm and germ cell, continues with the growth of the product under the most favourable conditions to adult life, and becomes gradually enfeebled with advancing age by the process of natural decay.

The constitution may be unsound in consequence of *deficient vitality.* This deficient vitality may be general, as is sometimes observed in the children of parents one or both of whom are in advanced life, or whose vitality on one side or the other has been reduced by excesses, such as alcoholic or venereal. Exhausted vitality from prolonged disease, *e.g.* phthisis or tertiary syphilis, affecting either parent, may determine the death of the offspring at an early period, from mere failure of nutrition, or may cause it to succumb to acute disease not necessarily associated with any inherited tendency of a special kind. The deficient vitality may be restricted to certain tissues or organs, namely, those concerned in the nervous, vascular, respiratory, or digestive systems. Thus amongst the most strikingly hereditary of diseases are those of degeneracy, such as emphysema, structural heart-diseases, atheroma of vessels, and certain kidney-diseases. Rightly interpreted, these diseases are of the nature of premature senility, attacking certain tissues or organs—as it may be seen to attack the hair or the cornea—from some inherent defect in their vitality.

The constitution may, in the second place, be unsound from some definite *inherited* form of disease. Although the constitution of an individual begins with his life, it is nevertheless the resultant of the constitutional peculiarities of many antecedents. This being so, tendencies to disease may date far back in the pedigree, to be called forth from time to time by favouring circumstances. We need, however, practically only go back a few generations in inquiring for those diseases which are well recognised as being hereditary. These form one section of the group of *constitutional diseases.* — Congenital syphilis, gout, scrofula, tuberculosis, cancer, asthma, and certain neuroses, are all diseases which are apt to appear at certain periods of the life of the offspring, in consequence of some specific inherent defect of blood or tissue derived from his progenitors.

The constitution may, thirdly, become unsound at any period *subsequent to birth.* (*a*) This may be due to the surrounding conditions of life being evil. Deficient or impure air, insufficient or improper food, defective sunlight, over-work, intemperance, &c., may injure the constitution, and give rise to diseases whose constitutional nature is sometimes strikingly shown in the tendency of some of them to become hereditary. Rickets, phthisis, and scrofula are examples. (*b*) The introduction of certain poisons into the system affects the constitution profoundly, and in some cases permanently, after the more obvious effects of the poisons have passed away. All the acute specific zymotic diseases, including vaccinia, would come under this category. They render the organism, for a long period or for life, proof against subsequent attacks of the same disease. Only in certain cases, however, can the soundness of the constitution be said to be *impaired* by such diseases, and then it is usually through the occurrence of sequelæ.

R. Douglas Powell.

CONSTITUTIONAL DISEASES. These may be regarded as diseases generated from within, in the course of the wear and tear, nutrition and waste, of the body, in consequence of inherent or acquired weakness in its construction.

The applicability of the term 'constitutional' to disease is sufficiently explained in the preceding article on Constitution. The term may, however, be associated with a group of so-called 'general' diseases, in opposition to that which includes 'zymotic' or 'specific' diseases, which are generated by the introduction of some definite poison from without.

In our present state of knowledge, however, no very rigid lines can be drawn to separate local, general, constitutional, and specific diseases from one another. *See* Disease, Causes of.

R. Douglas Powell.

CONSTRICTION (*constringo*, I bind together).—A narrowing, to a limited extent, of a canal or hollow organ, due either to a textural change in its walls, or to the pressure of a band surrounding it.

CONSUMPTION (*consumo*, I waste).—A term for any wasting disease, but generally applied to pulmonary phthisis. *See* Phthisis.

CONTAGION.—The word *contagion* is applied in pathology to the property and process by which, in certain sorts of disease, the affected body or part causes a disease like its own to arise in other bodies or other parts; and the Latin word *contagium* is conveniently used to denote in each such case the specific material, shown or presumed, in which the infective power ultimately resides. *See* ZYME; and ZYMOSIS.

The property of CONTAGIOUSNESS belongs to a very large number of the diseases which affect the *human* body. And in more than this direct way the property is of great interest to mankind. Contagiousness of disease is a fact not only for man, but apparently for all living nature; and the influence of contagion in spreading destructive diseases among *domestic animals,* and among those parts of the *vegetable kingdom* which contribute to the nourishment of man, is such as to make it of immense social importance that the laws of contagion should be well studied and understood. Further, just as contagion in the case of *living* bodies and their parts spreads disease from one to another, so, to an immense extent, in the case of certain matters which, though of organic origin, are *not living,* it spreads various processes of decay. The so-called 'fermentations' which yield alcohol and vinegar, as well as that in which putrefaction consists, are contagious affections of the respective matters in which they occur: every cheesemonger knows that moulds of different kinds spread by inoculation, each in its own kind, from cheese to cheese; and if the Greek proverb 'grape mellows to grape' is true of the living fruit, the apple-loft gives analogous experiences of contagion among the fruit which is garnered.

The RATIONALE of the word 'contagion' as now used, is that the property is understood to attach itself essentially to a material *contact*; not necessarily that, when infection is spread from individual to individual, the contact of the individuals must have been *immediate*; but that in all cases there must have been such passage of material from the one to the other, as was in itself at least a *mediate contact* between them. And similarly, in those very instructive illustrations of the process of contagion which are furnished within the limits of a single diseased body by the propagations of disease from part to part of it, we can in general easily see that infection advances from part to part, either in proportion as part touches part, or in proportion as the one receives from the other the outflow of lymph or blood or secretion.

The various SPECIFIC MATTERS which effect contagion in the living body, the respective 'contagia' of the given diseases, seem all to have in common this one characteristic: that in appropriate media (among which must evidently be counted any living bodily texture or fluid which they can infect) they show themselves capable of *self-multiplication*; and it is in virtue of this property that, although at the moment of their entering the body they in general do not attract notice, either as objects of sense or as causes of bodily change, they gradually get to be recognisable in both of these respects. Now, the faculty of self-multiplication is eminently one of the characters which we call *vital*; and when it is said that all contagia are self-multiplying things, this is at least very strongly to suggest that perhaps all contagia are things endowed with life.

In order to any general consideration of the question thus suggested, contagia may conveniently (even if but provisionally) be distinguished as of two main CLASSES, differing, or at present seeming to differ, from each other in their mode of action on the organisms which they infect: one class, namely, that of *Parasites*; and the other class, that of the true or *Metabolic Contagia.* Of this separation, so far as present knowledge seems to justify it, the assumed grounds are: that each true Contagium, in proportion as it multiplies in the body, *transforms,* in a way which is specific to itself, and is different from the ways of other contagia, the bodily material with which it has contact; while, on the contrary, the Parasite, however much it may grow or multiply in the body, produces no qualitative effects specific to itself, but only such effects as are of common kind to it and all other parasites—indications, namely, of its *mechanical intrusiveness* in the parts which it occupies, and sometimes of the *drain* which it makes on its host's general nutritive resources.

A.—Of PARASITES, in relation to processes of contagion, little needs be said in the present article. When an organism or part of it is, in greater or less amount, inhabited by other organisms, animal or vegetable, which subsist on it, or its food or refuse, it of course may be a centre of infection to other (if susceptible) bodies or parts, to which it can transmit live parasites or their germs or seeds: for, when this transmission takes place, growth and self-multiplication, as in a colony, are the natural results which have to be expected; and in proportion as these occur, the newly-infected body or part gradually gets to suffer, like the old, from those particular derangements which make the type of parasitic disease. Some parasitic diseases, especially some of those of the skin, spread actively by direct contagion in ordinary intercourse; as, for instance, scabies by the migration of its acari, and porrigo (among children) by the spores of its microphyte; and the spreading of such diseases where they exist may of course be to any extent facilitated by aggregation of persons and uncleanliness of personal habits. There are cases in which parasitic disease spreads from animal to animal only in proportion as the one feeds on the other, and eats it with parasites still living in it; or in proportion as live parasite-eggs or larvæ, discharged from the body of one animal, get conveyed with food (especially on raw herbage and in water) into the bowels of another. Considerable epidemics of trichiniasis in the human subject have been traced, chiefly in Germany, to infection from the pig; in cases where pork, abounding with trichinæ, has been eaten, as sausage-meat or otherwise, in a raw or imperfectly-cooked state: and in Iceland the very great sufferings of the human subject and the cattle from echinococcus have been traced to the influence of the dogs in spreading contagion from the slaughter-house, where they eat hydatidised offal, to the kitchen-gardens and water-sources and pastures, where they discharge tape-worm eggs from their bowels. *See* PORRIGO; SCABIES; ENTOZOA.

The DISEASED STATES which consist in being colonised by parasites are diseases of indefinite duration, tending in some cases to indefinite increase. In cases where the disease consists in the presence of swarms of blood-sucking or otherwise exhausting animal parasites, symptoms of the blood-drain will of course gradually arise; but otherwise the parasite, whether animal or vegetable, operates only as a mechanical presence. Skin and mucous membrane will be irritated in their superficial layers, and in some cases more deeply, by the animal or vegetable parasites which breed on or in them, just as they might be by dead mechanical irritants: solid organs having cystic entozoa in them will in like manner show evidence of irritation by encapsulating the colonists; and the surrounding tissue will of course suffer compression and displacement in proportion as the colonisation (*e.g.* in case of echinococcus) is compact and massive. In the case of trichiniasis—but, in our ordinary experience, in no other—the multiplication of the parasites, the burrowing of their young, and the general diffusion of these in the body, are processes of such extreme activity that, if the quantity of contagium taken into the stomach has been large, the innumerable local irritations suffice to make a very acute fever; but even in this extreme case, the merely irritative type, though exaggerated, is essentially preserved.

As different sorts of animals are notoriously liable to different sorts of parasites, so, even among animals of one sort—as, for instance, in the human kind—the LIABILITY of different bodies to receive particular parasite-infections, does not seem to be quite equal for all. Especially, the vegetable parasites seem to have their affinities determined or modified by the general state of health of the recipient; and there are cases in which it looks as if there ran in particular family-lines (perhaps with some slight chemical idiosyncrasy) a special liability to particular intestinal worms. There, however, is no reason to believe that in regard of the more important animal parasites, as particularly of trichina and the tæniadæ, the susceptibility of individuals to attacks is other than universal and practically equal.

B.—The true or METABOLIC CONTAGIA (to which the rest of the present article will exclusively refer)—the contagia which, in their respective and specific ways, operate *transformingly* on the live bodily material which they affect, are perhaps the most important of all the incidental physical influences which concern mankind. Whether they may all, at some time hereafter, admit of being named, like the parasitic contagia, in terms of biological classification, is a question which needs not in the first instance be raised; for meanwhile the identity of each separate true contagium is settled in experimental and clinical observation by the uniformity of the operation of each on any given animal body which it affects. Each of the diseases propagates itself in its own form in as exact identity as if it were a species in zoology or botany; and in each such repetition of the disease there is a multiplication—always a large, and sometimes an inconceivably immense multiplication—of material which has the same infective property. Evidences innumerable to that effect are under daily clinical observation in this climate in instances of smallpox, measles, scarlatina, whooping-cough, enteric fever, mumps, typhus, syphilis, cowpox, diphtheria, erysipelas, hospital gangrene, purulent ophthalmia and gonorrhœa, venereal soft-chancre and phagedæna, &c.; for, barring fallacies, no man ever sees any one of those diseases produced by the contagium of any other of them; and any man who has before him a case of any of them can see that, however minute may have been the quantity of contagium by which the disease was started, the patient's diseased body (part or whole) yields for the time an indefinitely large supply of the specific agent. It is more or less habitual to some of the diseases that the infectedness of the patient is first made known to the observer by such *general pyrexia* as tells of change already far advanced in the circulating mass of blood; and it is only after this has shown itself, that other symptoms, adding themselves to the fever, complete the more or less complex type which establishes the identity of the disease. But in many of the diseases it may be the case (either naturally or as the result of experimental infection) that the first, and in some diseases the main or even the only, effects of the contagion are *local changes*, passing where we can from the first observe them; and the broad facts of metabolic infection, as regards waste of bodily material with concurrent increase of contagium, are, in many such cases, among our most familiar experiences. Most instructive, too, are the facts of contagion which are to be learnt in the study of tubercle: the contagium, introducible either by tubercular and certain septic inoculations through the skin, or internally by the infective action of the milk or diseased organs of tubercular animals if taken as food; and the contagium, when introduced, gradually spreading as it multiplies, and as lymph and blood carry it from the first infection-spot to other organs which now will repeat the process. And similarly in cancer (though the primary disease is at present of unknown origin and cannot be created by experiment) the repetition of the primary disease in secondary and tertiary propagations in the body of the sufferer is one of the most striking of all evidences of contagion; because of the great number of structural types which pass under the name of cancer, and the fidelity with which each of them is reproduced in the organ to which the contagion extends. A further fact of contagion, deserving notice in the present context, is the local spread of certain of these processes by continuity of tissue; as, for instance, in the continuous extension of phagedæna or hospital-gangrene from any centre of first inoculation, or of tubercular softening or cancer at the place where it begins: a mode of extension which indicates successive infective actions of matter on matter in spheres of ever-widening circumference;[1] and the like of which, but in rudimentary degree, may be traced in the areola of any acute inflammation.

In the physiology of the metabolic contagia no facts are more characteristic or more important than those which show the RELATIVENESS of particular contagia to PARTICULAR RECEPTIVITIES of body.—First, and in intimate connexion, as would seem, with a *chemical electiveness* of action which will presently be imputed to contagia, there is the preference which some particular contagia (however introduced into the system) show for particular *organs* of the body; so that by the exercise of this preference, there is given to each of the diseases its own set of clinical and anatomical characters. Compare, as instances in this point of view, the respective local affinities of smallpox, enteric fever, mumps, syphilis, hydrophobia, &c.—Secondly, it may be noted that, in regard to some of the contagia, different *persons*, and particularly persons of different *family-stocks*, show original differences of susceptibility; original, namely, as distinguished from others, hereafter to be mentioned, which are acquired; so that, for instance, the severity with which scarlatina or diphtheria will strike in particular families contrasts with a comparative mildness of the same disease in other families, or perhaps even with cases of apparently complete personal immunity under exposure to the particular danger: and recent researches have seemed to suggest as possible that, in the very wide differences of degree with which tubercular disease prevails in different families, an essential condition may be, that the families have widely different degrees of original predisposition towards some of the septic contagia.—Thirdly, there is the extremely suggestive fact with regard to many of our best-known febrilising contagia, that they run a course of *definite duration*, and that in this course, provided the patient do not die, all present, perhaps all future, *susceptibility to the particular contagium is utterly exhausted from the patient*; so that re-introduction of the same contagium will no more renew that patient's disease than yeast will excite a new alcoholic fermentation in any previously well-fermented bread or wine. The inference from this fact seems unavoidable, that each such contagium operates with a chemical distinctiveness of elective affinity on some special ingredient or ingredients of the body; and that exhausting this particular material in febrile process, which necessarily ends when the exhaustion is complete, is the bodily change which the contagium 'specifically' performs.—Of not all metabolic contagia, however, can it be said that their operation runs so definite and self-completing a course. For, first, there are particular *acute infections* which, as a rule, kill; either (as appears to be the case in splenic fever when affecting man) because of the extreme magnitude of the transforming process which the contagium sets up, or else (as appears to be the case in hydrophobia) because the elective incidence of the contagium is on an organ indispensable to life; so that in such cases there is in fact hardly such an event as passing alive through the whole process of the disease. And, secondly, there are the *contagious dyscrasies* which are clearly characterised by their tendency to indefinite duration: syphilis, which oftener than not relapses in successive outbreaks, and often as years pass invades the body more and more deeply, and may after all never during life be ended; and tubercle and cancer, which, with almost invariable persistence, will in general steadily advance month by month to infect more and more of the body till the process eventuates in death.

The transmission of various contagious diseases IN COMMUNITIES is of course greatly influenced, both in detail and in aggregate, by such differences of individual receptivity as were mentioned in the last section. Notably, as regards communities through which particular acute infections have had full run, fresh sparks of the contagium may find little or no fuel on which to act; and much new diffusion of the disease may not again be possible, till immigration, or births, or lapse of time operating in other ways, shall have reconstituted a susceptible population. And, given the susceptible population, circumstances of time and place are infinitely various (especially as regards quantity and quickness of personal or quasi-personal intercourse) in determining how far this population shall have particular contagia thrown in its way.

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[1] Compare Tennyson's
'little pitted speck in garnered fruit,
Which, rotting inward, slowly moulders all.'

Also there are conditions, not primarily of a personal kind, which operate on a very large scale in determining the spread of some of the metabolic infections: giving to them respectively *at certain times*, in ways not hitherto understood, a *special increment of spreading-power*, and in some instances also *special malignity*: and thus enabling them respectively from time to time to come into comparative prominence in national life, and perhaps at once or successively in many different countries, in the form of so-called EPIDEMICS. Thus, it is matter of familiar knowledge that the fevers which are most habitual to this country—scarlatina, measles, smallpox, enteric fever—are of nothing like uniform prevalence; that scarlatina, for instance, will be three times as fatal in one year as in another, and that smallpox is liable to even greater exacerbations: and it is known that temporary differences of this kind are not exclusively local; that, for instance (to quote a late official report), 'the epidemic of smallpox which began in England towards the close of 1870 and terminated in the second quarter of 1873 was part of a general epidemic outbreak of that disease, of worldwide diffusion, marked wherever it occurred by an intensity and malignity unequalled by any previous epidemic of the disease within living memory.' The wider the survey which we take of epidemiology, the more certain it becomes to us, that, outside the conditions which are independently personal or local, there are *cosmical conditions* which have to be considered. Doubtless there are great epidemiological facts—such, for instance, as the first spreading of smallpox to America, or in our own times the increasing frequency of Asiatic cholera in Europe, which may be ascribed to novel conditions of international intercourse; but there are others, equally great, to which apparently no such explanation can be applied. For what reason it is that cholera every few years has its definite fit of extension in India,—or why diphtheria, which scarcely had a place in history till it overran Europe in the 16th century, and which since then had been rarely spoken of, began again some twenty-odd years ago to be comparatively important in England,—or why the plague of the Levant has for the last two centuries been so unfamiliar to us,—or why the yellow fever of the Mississippi has in particular years raged furiously in parts of Europe,—or why our black-death of the 14th century, though apparently still surviving in India, has never but that once been in Europe,—or whither has gone our sweating-sickness of three centuries ago,—or whence have come the modern epidemics of cerebro-spinal meningitis: these, and many like questions, which cannot at present be answered, seem to be evidence enough that, in the making of epidemics, contagion and personal susceptibility may be factors in a partly *conditional* sense. Influences which are called 'atmospheric'—the various direct and indirect influences which attach to the normal succession and occasional abnormality of seasons, in respect of the insolation of our planet, and of the temperature and humidity of air and earth—are in general far too vaguely regarded as elements of interest in the present question, but are possible factors which no epidemiologist should omit from scientific consideration. For any definite knowledge which exists on the relation of particular conditions of season to the prevalence of particular epidemics, the reader is referred to the article EPIDEMICS, and to articles on the respective diseases.

In the PASSAGE of the metabolic contagia FROM PERSON TO PERSON various agencies may be instrumental,—bedding or clothing or towels which have been used by the sick, dirty hands, dirty instruments or other utensils, the washerwoman's basket, foul water-supply, stinking house-drains, contaminated milk or other food, the common atmosphere, &c.; but differences of that sort are only differences as to the *means by which such communication is established with a diseased body* as brings its products into relation with healthy persons; and the disengagement of *infectious products* from the bodies of the sick is pathologically the one influential fact. As regards the products which ought to be deemed infectious, the specially-diseased surfaces and organs of the patient, and the discharges and exhalations which they respectively yield, must always be regarded with chief suspicion; but suspicion, however much it may insist on them, must never disregard other sources of danger. Of some of the metabolic contagia we practically know, and of many of the others we may by analogy feel sure, that, when a given body is possessed by one of them, no product of that body can be warranted as safe not to convey the infection. Presumption against every part and product of the diseased body is by everyone readily admitted where there are vehement general symptoms of disease: but it is important to know that not only in such febrile states, but even in states of chronic dyscrasy, and even at times when the dyscrasy may be giving no strong outward sign, the infected body may be variously infective. Thus, in regard to constitutional syphilis, it is certain that the mere utero-catarrhal discharge of the syphilitic woman, or the sperm of the syphilitic man, or the vaccine lymph of the syphilitic infant, may possibly contain the syphilitic contagium in full vigour, even at moments when the patient, who thus shows himself infective, has not on his own person any prominent outward activity of syphilis. Similarly, in regard to tubercular disease, experiment has proved beyond question that the milk of animals suffering from tubercle will, if taken as food by other animals, infect them through the intestinal mucous membrane: and there are independent reasons for believing that the tubercular contagium (like the syphilitic) will at times during the dyscrasy be contained in the seminal fluid, and that men, tubercular perhaps only in some degree which is not immediately important to themselves, may by that secretion convey fatal infection to women with whom they have conjugal relations.[1] Regarding many of the metabolic contagia, conclusive evidence exists that, when they are in operation in pregnant women, the fœtus will in general be infected by them; and this though the diseases (*e.g.* smallpox, cholera, syphilis) be of the most different pathological types: but with regard to pregnant animals affected with splenic fever it is noticeable that Brauell, in his extensive researches, found the blood of the fœtus not to be infective.

In general, each contagium has its own favourite WAY OR WAYS OF ENTERING THE BODY; and these preferences are not only of speculative interest, as attaching to varieties of nature and natural habits among the contagia, but are of obvious practical importance as measures of the widely different degrees in which the different contagia are qualified to spread in communities. Thus, *inoculation at broken surfaces* of skin or mucous membrane has long been known as the ordinary mode by which the infections of syphilis, hydrophobia, splenic fever, cowpox, and farcy or glanders, get admission to the body; and our best knowledge of some other infectious diseases (notably of tubercle) has been derived from inoculations intentionally made with their contagia for purposes of study. While probably all infections which tend to be of general action on the body can be brought into action in that way, and while some infections are not known to pass by any other mode of transmission, there are many infections which spread freely from subject to subject by *atmospheric and dietetic communication*; and the meaning of these preferences is hitherto not fully known. It seems that some contagia are so acted upon by air and water, that they seldom or never reach the body in an effective state by those common means of communication,—some hardly, if at all, by water, and some not by air except with very close intercourse; and further, that, of contagia which reach the body in an effective state, some require, while others do not require, that an abnormal breach of surface shall give them special opportunity for taking hold. In some of the cases where a disease can be propagated in both ways,—*i.e.* certainly in smallpox, and apparently also in bovine pleuro-pneumonia, the artificially inoculated disease tends to be much milder than the disease otherwise contracted; but pathologically it is difficult to conceive any essential difference between those different modes of contagion. It may be presumed that, in the modes which are not by true inoculation, acts which are comparable to inoculation take place on internal surfaces; that, for instance, when particles of scarlatina-contagium are caught in the tonsils, or inhaled into the bronchi, or swallowed into the stomach, they begin by penetrating the texture of the mucous membrane, and by thus effecting as real an inoculation, with regard to the blood, as that which art or accident provides in other cases through the punctured skin. That previous abnormal breach of surface by artificial puncture or otherwise is not necessary to allow the infection of mucous surfaces is illustrated in ophthalmia and gonorrhœa; where apparently no other condition has to be fulfilled than that a particle of the blenorrhagic contagium shall be deposited on the natural surface of the mucous membrane. It deserves notice that, while a considerable number of the worst diseases of the domestic animals admit of being communicated to man by artificial inoculation, atmospheric communication seems to be very inapt, if not absolutely unable, to infect man with any one of them; and in this connexion it may be of interest to remember that syphilis, one of the most familiar of human infections, but hitherto not traced to any brute ancestry, differs from our other current infections in requiring inoculation to transmit it.

When any metabolic contagium enters the animal body, it requires an INTERVAL OF TIME, and in most cases a considerable interval, before its morbific effects can become manifest even to skilled observation. The period of latency or so-called INCUBATION varies greatly in different cases. In hydrophobia it is very rarely less than of one month, is certainly often of several months, and is said to be sometimes of years. In syphilis the inoculated spot remains generally for at least a fortnight, and may remain even as much as five weeks, without any ostensible change; and the roseola of the general infection will not be seen till some weeks later, when generally at least three months will have elapsed since the first inoculation. In the acute eruptive fevers, when their contagium is transmitted by air, the first changes which ensue on infection are not external, and we cannot be sure what early internal changes may take place; but in smallpox, the fever (which is the first overt sign) does not attract notice till about the twelfth day after infection, nor the eruption till two days later; and in measles the incubation-time, though perhaps less uniform, seems to be little (if any) shorter than that of smallpox. The septic contagia and the contagium of splenic fever seem to be of particularly quick operation; but even the most virulent septic contagium, when without admixtures which tend to complicate its action, will not begin sensibly to derange the infected animal till at least several hours after it has been inoculated. As regards the contagia last referred to, it is conceivable that the self-multiplication of the contagium in the form in which it proves fatal to life is a process which goes on continuously and uniformly from the moment of inoculation to the moment of death, and that the moment when signs of general derangement become manifest is the moment when this uniformly-advancing process has accumulated in the system a certain quantity of result:—but it does not seem easy to apply this explanation to the diseases of long incubatory period; and we can hardly conjecture what may be the latent processes—for instance of smallpox, during the first ten or more days after contagium has been received.

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[1] See Dr. Weber, in *Clin. Soc. Trans.*, 1874.

It is not yet possible to say, in any universal sense, with regard to the metabolic contagia, what is the ESSENTIAL CONSTITUTION of 'contagious matter,' or what the INTIMATE NATURE of the 'transforming power' which the particle of such matter exercises on the particles which it infects.—As regards the question of the FORCE, chemists, when they refer in general terms to the various acts which they designate *acts of fermentation*, allege that certain processes of change in certain sorts of organic matter induce characteristic changes in certain other sorts of organic matter, not by the common chemical way of double decomposition with reciprocally new combinations, but (so to speak) as a mere by-play or collateral vibration-effect of the chemical force which is in movement; and though language can hardly be more vague than this for any scientific purpose, it expresses clearly enough the conviction of experts that a certain great force in nature lies beyond their power even of definite nomenclature, much more of exact identification and measurement. In that most interesting, but most difficult and hitherto almost uninvestigated, branch of chemical dynamics, we are supposed to have our nearest clue to the scientific problems of the present subject-matter. It may be conceded that the 'contact-influences' which are dimly recognised as causing the fermentatory changes of dead organic matter have apparent analogues in many of the morbid influences of contagion: for the changes which chemists call 'fermentatory' are all catalytic or disintegrative of the organic compounds which they affect; and when living protoplasm is brought by contagion into processes of *characteristic decay*, the analogy seems sufficiently close to justify the word *zymotic* in the naming of the nature of the process. But it must not be forgotten that, among immediate effects of contagion in the living body, are cases wherein the process (so far as we can yet see) is primarily not *catalytic* or *dis*-integrative, but, on the contrary, *anaplastic* or *con*-structive. Thus, when tubercle gives rise to tubercle, whether by secondary or tertiary infection in a single diseased body, or by infection from the sick to the healthy, each new tubercle which the contagion brings into being is a *growth-product* of the texture which bears it. And similarly, when the innumerable varieties of cancerous tumour propagate themselves by contagion, each after its special type, in the bodies of the respective sufferers, it is growth, not disintegration, which we first see. It would seem that in those cases of anaplastic 'contact-influence' something far beyond the analogy of chemical fermentations must be involved; and, in view of some of them, the physiologist has to bethink himself of the analogy of that 'contact-influence' which becomes the mainspring of all normal growth and development, when the ovum receives spermatic impregnation.—As regards the ultimate ORGANIC CONSTITUTION of the several metabolic contagia—(each of them of course abstracted from accidental admixtures, and seen or conceived in the smallest and simplest units of quantity and quality in which its specific force can be embodied)—modern research seems more and more tending to show that the true unit of each metabolic contagium must either be, or must essentially include, a *specific living organism, able to multiply its kind.* For with regard to those other contagia (as we may properly call them) which spread fermentatory processes in common external nature, and of which it is as clear as of the morbific contagia that they multiply themselves in proportion as they act, it seems to be established beyond reasonable doubt that the 'self-multiplication' of each of them as it acts is the self-multiplication of a specific microphyte; and that, directly or indirectly, the microphyte's self-multiplying life is the force which originates the fermentation.[1] This being the case in regard of those fermentations (and the more intimate nature of the process needs not just here be discussed), it seems probable that the same is in substance true of the specific morbid changes which extrinsic contagia produce in the materials of the living body—probable, namely, that low, self-multiplying organic forms, specific in each case for the particular disease which is in question, are essential to each morbid poison; that the increase of each contagium as it acts is the characteristic self-multiplication of a *living thing*; and that *this* (however obscure may yet remain its mode of operation) is the *essential originator of change* in the affected materials of the diseased body. The fact that low organic forms of the sorts now spoken of have often, or generally, been seen in the morbid products and tissues of persons with zymotic disease, would not by itself be a proof, or nearly a proof, that the forms are causative of the morbid change: for obviously they might be mere attendants on the necrosis and decomposition of bodily material, availing themselves of the process (just as certain insects would) to feed and multiply: and in many of the cases in which micrococci have been seen in morbid material, no direct proof could be given that the meaning of their presence was more than that. There are, however, some cases in which this proof has been completely established; and though such cases are at present but few, the significance of each of them in aid of the interpretation of other cases is of the highest importance. The researches of successive able observers in regard of the splenic fever of farm-stock, and those of Dr. Klein in regard of the 'pneumo-enteritis' (as he names it) of swine, have shown that in each of these cases the microphyte which attends the disease is botanically specific; that it and its progeny can be conducted through a series of artificial cultivations apart from the animal body; and that germs thus remotely descended from a first contagium will, if living animals be inoculated with them, breed in these animals the specific disease. It is equally well known that the organisms (spirilla) which are found multiplying in the blood during the accesses of relapsing fever are botanically specific: but in regard to this disease, experimental proof has not hitherto been given that the spirilla, if separately inoculated, will infect with relapsing fever. Studies as complete as those which have been made in splenic fever and pneumo-enteritis will no doubt sooner or later be made in regard to many other of the diseases, but their progress will necessarily be slow; partly because the objects which have to be scrutinised, and to which specific characters have to be assigned, are so extremely minute, and often so similar among themselves, that none but very skilled and very patient microscopical observers are competent to pronounce on them; and partly again because the conditions of the case are such as to limit very closely the field within which the essential experimental observations can be made. Meanwhile, however, the two diseases, regarding which the larger knowledge has been obtained, must be regarded as highly suggestive in regard of other diseases of the same pathological group, and particularly as giving importance to fragments of evidence (not by themselves conclusive) which have been gathered of late years in studies of some of these other diseases. Eminently this is true of the large family of the septic infections—including, on the one hand, erysipelas and pyæmia with its congeners, and having, on the other hand, tuberculosis intimately associated with it; and almost equally it is true of enteric fever and cholera and diphtheria, and of the smallpox of man and beast. Thus, though it would be at least premature to say of these diseases that they certainly have as their contagia *microphytes respectively specific* to them, it seems at present not too much to say that probably such will be found the case; and if as much may not yet be said of many other diseases which are due to metabolic contagia, it must be remembered that the right lines of study relating to contagia in this point of view have not till within very recent times been opened. *See* Postscript, 1.

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[1] In regard of some of these common-world ferments, it seems pretty certain that their characteristic microphytes operate *mediately*—that is to say, by means of special zymotic matters which they respectively produce, and which when produced can be mechanically separated from them: but whether this be true of all the same class of agencies does not hitherto seem fully settled. So far as it may prove to be true for them, that the microphyte is not itself the ferment, but is the producer and evolver of the ferment, the case of these ferments would be in parallelism with that of the chylopoietic and other functional ferments which more highly organised creatures produce for the purposes of their own economy. In the latter case the distinction between the ferment-yielding live bodies (say certain gastric cells) and their not-live product (say pepsin) is already familiar.

Of the NATURAL HISTORY of the contagia, considered independently of the part which they play in the living body, there are hitherto only the beginnings of knowledge. The absolutely first origin of contagia may perhaps not be more within reach of scientific research than the absolutely first origin of dog or cat; but their nearer antecedents—the states out of which they come when first about to act on the living body, and generally the variations which they and the common ferments exhibit under natural and artificial changes of circumstance, are within easy reach of investigation; and those humbler studies are likely to give very useful results. For some of our cases we seem to have an instructive analogy in the facts which Professor Mosler has put together in explanation of the blue-milk contagium of dairies—facts showing that the omnipresent penicillium glaucum, if its spores happen to alight in particular (morbid) sorts of milk, will operate distinctively on their casein as an anilin-making ferment, rendering the milk blue and poisonous, and imparting to each drop of it the power to infect with a like zymosis any normal milk to which it may be added.[1] In our own more special field, pathologists have already learnt that certain of the so-called 'morbid poisons' —the contagia of erysipelas, pyæmia, and tuberculosis, are intimately related to the common ferment or ferments of *putrefaction*; and that the most vehement of these contagia can be developed by the artificial culture of successive transmissions in the living body from the comparatively mild

[1] Virch. *Arch.*, vol. xliii

contagium of any *common inflammatory* process.[1]

Two other directions suggest themselves as likely to lead to fields of useful observation and experiment. On the one hand, in *comparative pathology*, and with the tracing of contagion from animal to animal, there is the possibility that at last some lower and relatively worthless order of animals may be found the starting-ground of fatal infections for higher orders ; and this, perhaps, by contagia which in their former relations are of mere inflammatory significance. On the other hand, in *geographical pathology*, and with the tracing of contagion from place to place, local centres of contagium-origination may possibly be found, in which the contagium, before it enters the animal body, will show itself an independent microphyte of the earth, first operating on the animal body as the essential force in a local malaria. Some of the worst pestilences known to the human race—yellow fever, cholera, perhaps plague, and also some of the diseases of cattle, have in their history facts which suggest that sort of interpretation : the supposition, namely, that certain microphytes are capable of thriving equally (though perhaps in different forms) either without or within the animal body; now fructifying in soil or water of appropriate quality, and now the self-multiplying contagium of a bodily disease. In regard to our own common ague-poison there seems every reason to suspect that its relation to soil is that of a microphyte; and though we know ague only as practically a non-contagious disease, we do not know that any little transfusion of blood from sick to healthy would not show it to be (in that way) communicable from person to person. *See* Postscript, 2.

It needs hardly be said that exact scientific knowledge of the contagia, and of their respective modes of operation, is of supreme importance to the PREVENTION OF DISEASE. With even such knowledge of them as already exists, diseases which have in past times been most murderous of mankind and the domestic animals can, if the knowledge be duly applied, be kept comparatively, or absolutely, in subjection ; and the fact that at the present time fully a fifth part of the annual mortality of the population of England is due to epidemics of contagious disease is only because of the very imperfect application hitherto made of that knowledge. In the present article it is not necessary to state in detail the practice which ought to be adopted in the various different cases of infectious disease ; but briefly it may be said that one principle is at the root of all such practice, whatever the disease to which it relates. This principle, which of course becomes more and more important in proportion as the infection is dangerous, and as the persons whom it would endanger are many, is the principle of *thoroughly effective separation* between the sick and the healthy: a separation which, so far as the nature of the disease requires, must regard not only the personal presence of the sick, but equally all the various ways, direct and indirect, by which infective matters from that presence may pass into operation on others. Especially as regards the diseases which make serious epidemics, the principle of isolation is not carried into effect unless due care be taken to thoroughly disinfect in detail all infective discharges from the sick, and all clothing and bedding and towels and like things which such discharges may have imbued, and finally, as regards certain contagia, the rooms in which the cases have been treated; and in order to secure these objects, it is essential in all grave cases to make such nursing-arrangements and such arrangements of the sick-room (whether private or in hospital) that no retention or dissemination of infectious matters will escape notice. It is likewise essential that all who attend on the sick should be careful not to carry contagion to other persons; as they may but too easily do, particularly in scarlatina and in certain traumatic and puerperal infections, if they omit to take special precautions against the danger. *See* articles QUARANTINE ; DISINFECTION ; and PUBLIC HEALTH ; and those on the special diseases. *See* also Postscript, 3.

The SOCIAL CONDITIONS through which, in our own country at the present time, the more fatal infectious diseases are enabled to acquire *epidemic diffusion* are chiefly such as the following :—that persons first sick in families and districts, instead of being isolated from the healthy, and treated with special regard to their powers of spreading infection, are often left to take their chance in all such respects ; so that, especially in poor neighbourhoods, where houses are often in several holdings, and where always there is much intermingling of population, a first case, if not at once removed to a special establishment, will almost of necessity give occasion to many other cases to follow ;—that persons with infectious disease, especially in cases of slight or incipient attack, and of incomplete recovery, mingle freely with others in work-places and amusement-places of common resort, and, if children, especially in day-schools ; and that such persons travel freely with other persons from place to place in public conveyances ;—that often, on occasions when boarding-schools have infectious disease getting the ascendant in them, the schools are broken up for the time, and scholars, incubating or perhaps beginning to show infection, are sent away to their respective, perhaps distant, homes;—that keepers of lodging-houses often receive lodgers into rooms and beds which have recently been occupied by persons with infectious disease and have not been disinfected;—that persons in various branches of business relating to dress (male and female) and to furniture, if they happen to have infectious disease, such as scarlatina or smallpox, on their premises, probably often spread infection to their customers by previous carelessness as to the articles which they send home to them; and that laundries further illustrate this sort of danger by carelessness in regard to infected things which they receive to wash;—that purveyors of certain sorts of food, if they happen to have infectious disease on their premises, by carelessness spread infection to their customers;—that streams and wells with sewage and other filth escaping into them are most dangerous means of infection, especially as regards enteric fever and cholera;—and that great purveyors of public water-supplies, so far as they use insufficient precautions to ensure the freedom of their water from such risks of infectious pollution, represent in this respect an enormous public danger;—that ill-conditioned sewers and house-drains, and cesspools receiving infectious matters, greatly contribute to disseminate contagia, often into houses in the same system of drainage, and often by leakage into wells. Of the dangers here enumerated, there is perhaps none against which the law of England does not purport in some degree to provide. At present, however, they all are, to an immense extent, left in uncontrolled operation; partly because the law is inadequate, and partly because local administrators of the law often give little care to the matter; but chiefly because that strong influence of national opinion which controls both law and administration cannot really be effective until the time when right knowledge of the subject shall be generally distributed among the people, and when the masses whom epidemics affect shall appreciate their own great interest in preventing them.

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[1] See particularly Professor Sanderson's papers in successive yearly volumes of *Reports of the Medical Officer of the Privy Council* from 1868 to 1877. It concerns the second fact mentioned in the text to remember that apparently every 'common inflammatory process' includes more or less of textural changes which are necrotic and of septic tendency. See *Holmes's System of Surgery*, first edition, article 'Inflammation.'

Whenever that time shall come, probably the public good will be seen to require, with regard to every serious infectious disease which is apt to become epidemic, that the PRINCIPLES which ought to be accepted in a really practical sense, and to be embodied in effective LAW, are somewhat as follows:—(1) that each case of disease is a public danger, against which the public, as represented by its local sanitary authorities, is entitled to be warned by proper information; (2) that every man who in his own person, or in that of anyone under his charge, is the subject of such disease, or is in control of circumstances relating to it, is, in common duty towards his neighbours, bound to take every care which he can against the spreading of the infection; that so far as he would not of his own accord do this duty, his neighbours ought to have ample and ready means of compelling him; and that he should be responsible for giving to the local sanitary authority proper notification of his case, in order that the authority may, as far as needful, satisfy itself as to the sufficiency of his precautions; (3) that so far as he may from ignorance not understand the scope of his precautionary duties, or may from poverty or other circumstances be unable to fulfil them, the common interest is to give him liberally out of the common stock such guidance and such effectual help as may be wanting; (4) that so far as he is voluntarily in default of his duty, he should not only be punishable by penalty as for an act of nuisance, but should be liable to pay pecuniary damages for whatever harm he occasions to others; (5) that all who are in attendance on any case of infectious disease should be similarly bound to use every proper care and precaution not to carry the infection to any other person; (6) that the various commercial undertakings which in certain contingencies may be specially instrumental in the spreading of infection—water-companies, dairies, laundries, boarding-schools and day-schools, lodging-houses, inns, &c., should respectively be subject to special rule and visitation in regard of the special dangers which they may occasion; and that the persons in authority in them should be held to strict account for whatever injury may be caused through neglect of rule; (7) finally, that every local sanitary authority should always have at command, for the use of its district, such hospital accommodation for the sick, such means for their conveyance, such mortuary, such disinfection-establishment, and generally such planned arrangements and skilled service, as may, in case of need, suffice for all probable .requirements of the district. *See* Postscript, 4.

Persons who are imperfectly acquainted with the scientific and social facts relating to the present subject-matter, or who have never seriously considered them, may think it would be over-sanguine to expect any general recognition of principles so peremptory as the above may at first appear to them; but, if so thinking, they would perhaps have under-estimated the rapidity with which knowledge is now increasing as to the common interests and mutual duties of mankind in respect of dangerous infectious disease. In the year 1865, when the so-called cattle-plague or steppe-murrain was imported afresh, as a long-forgotten disease, into this country, and was found to affect very large pecuniary interests, primarily of the chief landowners of the United Kingdom, and secondarily of other classes, an immensely valuable stimulus was given to the education of the country, and especially of its Legislature, in regard to the preventibility of the infectious diseases. And the remarkable zeal and ability which from that time onward have been shown, in providing adequate laws and admirable administrative arrangements against the diffusion of steppe-murrain and other infectious diseases of Farm-Stock, are not likely to be found permanently absent in relation to the interests of Human Life, when once the true bearings of the subject shall have got to be popularly understood. JOHN SIMON.

POSTSCRIPT.—In revising, for the reprint of the Dictionary of Medicine, the above article, written in 1878, the writer has been able to leave the original text almost entirely without change, but has to add the following few remarks referring to steps of later progress.

1. First, with regard to the exact science of Contagion, knowledge of microphyte-life as the power of the metabolic contagia has during the past twelve years advanced considerably both in extent and in minute accuracy, and is rapidly tending to consolidate itself into general law. Work of especial value in that line has been done by Dr. Klein in respect of scarlatina and diphtheria, and also of the foot-and-mouth disease of farm-stock.

2. And with regard to the question of cases in which perhaps the microphytes of given diseases, before infecting the human body, may have multiplied in soils or waters of appropriate quality, an extremely interesting line of research has been opened by Dr. Ballard in his study of the ætiological relations of summer diarrhœa.

3. With regard to the proper action of Local Authorities against the spreading of dangerous contagions in their districts, it has to be noticed that, in 1889, an important step towards supplying the first requisite for such action was represented by the passing of an Act for the compulsory local Notification of cases of Infectious Disease (52 & 53 Vict., cap. 72).

4. Within the last few years, by the admirable studies of Mr. Power and Dr. Klein, it has been made almost certain that scarlatina and diphtheria are diseases common to man with at least some of the animals which are most intimately in his service: both of them appearing to be capable of affecting bovine animals, and to be communicable by means of cows' milk, while diphtheria appears also to be a disease which spreads among cats: and, with this extremely important addition to knowledge which previously existed, the consequence is now strongly suggesting itself that systems of law and administration intended to guard human society against dangerous infections of disease, must extend to the provision of adequate means for observing and controlling the infectious diseases of domestic and farm-yard animals, and for securing that the public health shall not be jeopardised through the negligent or wilful distribution of infected milk. J. S.

CONTINUED FEVERS.

CHARACTERS.—Under the name of Continued Fevers is included a group of diseases which have the following characters in common:—

1. They are attended with *pyrexia*, or a febrile condition sustained for a more or less definite period of considerable duration, without intermission or very decided remission, and not due to any local inflammation. That is, the fever is *essential*, and not merely *symptomatic*. The distinguishing feature of pyrexia is unnatural elevation of the temperature of the body; but there are other symptoms scarcely less constant—increased frequency of the pulse, thirst, loss of appetite, furred tongue, headache, chilliness, and—if the temperature is high—various manifestations of disturbance of the nervous system.

2. They are clearly due to the introduction into the body of a *poison from without*, and this poison is *reproduced in the system*, so that continued fevers are communicable directly or indirectly from the sufferer to others. This statement would not apply to simple continued fever so called; but simple continued fever, when not a mild or abortive attack of one or other of the specific fevers, has scarcely anything in common with them.

3. The continued fevers rarely affect the same individual twice. An attack is *protective against subsequent attacks* of the same fover. This is much less manifest in relapsing than in typhus and enteric fever.

4. The continued fevers have a more or less *definite duration*. A certain time intervenes between the exposure to the poison and the onset of the disease, which is called the period of incubation; and the disease is divisible into the stages of invasion, dominance, and decline.

5. In two out of three continued fevers there is a characteristic *cutaneous eruption*.

ENUMERATION.—The continued fevers are typhus, enteric, and relapsing fever. Common continued fever, or febricula, often associated with them for the sake of convenience, resembles them only as consisting in pyrexia not traceable to any known local inflammation. It does not conform to the characteristics enumerated, and cannot be brought within any definition which applies to the true fevers.

DIAGNOSIS.—The continued fevers have to be distinguished from the intermittent and remittent fevers on the one hand, and from the eruptive fevers and some other diseases on the other.

1. From *intermittent* and *remittent* fevers they are distinguished clinically by the comparatively sustained high temperature; but were this all, the continuous character sometimes assumed by intermittents and the remittent type occasionally seen in enteric fever—especially in children—would bring them close together. The essential distinction is that indicated under the second head, and is

mainly ætiological. Both kinds of fever are due to a poison received from without; but while in continued fevers the source of the poison is for the most part a previous case of fever of the same kind, and the poison is generated anew in the subject of the disease, remittents and intermittents are of malarious origin, and the poison is never reproduced in the system, and therefore never communicated by the sufferer.

The formation of the specific contagium of continued fevers within the system during the disease is of course the cause of their spread by contagion. The mode of this spread is different for the different fevers. Typhus and relapsing fever are directly contagious in an eminent degree; the poison is contained in the emanations from the skin or lungs, and is capable of entering the blood of healthy persons by being breathed or swallowed; it may also be carried by fomites. Enteric fever, if directly contagious at all, is very slightly so; the contagium is apparently not given off in the breath or perspiration, but chiefly or exclusively from the bowels, and the disease is spread mainly by the contamination of drinking-water, or, more rarely, by sewer gases or by the emanations from typhoid excreta, especially after long residence in sewers.

2. The distinctions between the continued and the *eruptive fevers* remain to be pointed out. They are of a very slight character. All the characters given of the continued fevers, including the occurrence of a cutaneous eruption, are common to them and the eruptive fevers. The differences are as follows:—

(*a*) The liability to the eruptive fevers is almost universal in the absence of protection by a previous attack, and is little affected by the state of health of the individual, while the liability to continued fever is very variable in different persons, and even races, and is greatly influenced by external conditions. There is no parallel in the eruptive fevers to the predisposition to typhus and relapsing fever generated by overcrowding and famine.

(*b*) The protective influence of a previous attack is more marked in the eruptive fevers, though not to such a degree as would constitute an important distinction. Instances of small-pox after a previous attack, or after vaccination, and second attacks of measles and scarlet fever, are not very uncommon.

(*c*) While in the eruptive fevers the specific poison is considered to be invariably derived from a previous case, this cannot be said with the same confidence with regard to the continued fevers. It is true that, in by far the largest proportion of attacks of typhus, enteric, and relapsing fevers, the source of the poison can be traced, and that as the experience and trained skill brought to bear on the search increase, the fewer are the examples in which it fails; but it cannot yet be said definitely that these fevers are not generated anew under certain conditions. The constancy with which typhus and relapsing fever follow in the track of overcrowding and starvation is suggestive of spontaneous origin; but in this country typhus is never so completely extinct that foci of infection are wanting, and epidemics of relapsing fever may be imported. Enteric fever, again, appears from time to time under circumstances which appear to exclude the possibility of the poison having been derived from a previous case, though in most instances of epidemic prevalence of the disease, there is conclusive evidence of specific, and not merely general, contamination of the air or water. It is not, however, necessary to enter upon this controversy here, or to do more than allude to the question whether or not their contagia are of the nature of organic germs. *See* CONTAGION; and ZYME.

The fevers will be fully described under their respective names.

WILLIAM H. BROADBENT.

CONTRACTION, Muscular (*contraho*, I draw together).—A term applied to the action or to the shortening of a muscle from any cause, whether in health or in disease. *See* SPASM.

CONTRA-INDICATION.—Any circumstance which forbids the employment of therapeutic measures otherwise indicated.

CONTRE-COUP (Fr.), Counter-stroke. An injury of a part opposite to but distant from that to which force is applied, as by a fall or direct blow. Contre-coup is chiefly observed in injuries of the skull.

CONTUSION (*contundo*, I bruise).—A bruise or injury of the soft parts without breach of surface.

CONVALESCENCE (*con*, with; and *valesco*, I grow well).—The *period of convalescence* signifies that period during which a patient is progressing towards recovery, and is returning to a state of health after having suffered from an illness. When the health has been completely restored, convalescence is said to be established, and the patient is regarded as convalescent. The word is used most commonly in association with fevers, inflammatory diseases, and other acute affections. Convalescence may be ushered in by a crisis, and become speedily established; or it may be very slow and protracted in its progress, which is also often interrupted by relapses, complications, or sequelæ. Patients frequently require careful watching and judicious treatment while becoming convalescent, as they are apt to retard or even prevent their recovery, and to lay the foundation for permanent disease, by neglect of due precautions, especially as regards their diet. Much injury is not uncommonly inflicted by the injudicious administration of medicines, and the employment of other means which are supposed to hasten convalescence; but, on the other hand, it can undoubtedly often be promoted by suitable measures.

Frederick T. Roberts.

CONVOLUTIONS OF THE BRAIN and CORTEX CEREBRI, Lesions of. The pathology of the cortex cerebri is still comparatively in its infancy. The older records and observations, made while the idea was still prevalent that the convolutions of the brain had no definite dispositions and relations, and that the various parts of the hemispheres were functionally equivalent, are not sufficiently exact to be made the basis of trustworthy clinical and physiological conclusions. Recent anatomical investigation into the topography and homologies of the cerebral convolutions, and the experimental researches of Hitzig, the writer, and others in reference to the results of electrical irritation of the brain, have directed greater attention to accurate topographical descriptions of the lesions of the cortex in connexion with observed clinical symptoms. Up to a comparatively recent date physicians and physiologists generally held by the views of Flourens, based on experimental investigation of the brains of the lower classes of animals. According to Flourens the hemispheres were concerned purely with intelligence—a faculty one and indivisible; and each part of the hemisphere possessed the functions of the whole, so that, if part were destroyed, functional compensation might be effected by the parts which remained. These views seemed satisfactorily to explain the cases, not uncommon, in which, notwithstanding the existence of extensive lesions in the hemispheres, no symptoms were observed during life. The frequent association of aphasia with a limited lesion of the cortex cerebri, vaguely indicated by Bouillaud and Dax, and definitely fixed by Broca at the posterior extremity of the third left frontal convolution, was a step towards localisation of function in the brain, which, however, met with much opposition and counter-facts. The clinical and pathological observations of Hughlings Jackson in reference to the causation of limited and unilateral epileptiform convulsions were an important contribution to the physiology and pathology of the cortex. These convulsions he attributed to irritative or discharging lesions of the grey matter in the neighbourhood of the corpus striatum in the opposite hemisphere.

Physiological experiment has demonstrated the correctness of the views advanced by Hughlings Jackson, and shown that, not only can movements be excited by electrical irritation of certain regions of the cortex, but also that definite combinations of muscular movements uniformly result from stimulation of certain specialised areas within this region.

Physiological experiment is, as to precision in its results, considerably in advance of clinical observation, and, from the nature of the two methods, this is what might be expected.

The investigation of diseases of the brain is surrounded by special difficulties. Though, as shown by physiological experiment, the brain is capable of being mapped out into different regions possessing different functions, yet the brain acts as a whole, and it is not always easy to analyse the facts of disease, and to distinguish with certainty between the effects directly dependent on the locality of the brain, and those due to the indirect influence exerted on the functions of neighbouring regions and on the brain as a whole.

That the brain is diseased in insanity, functionally or organically, is a fact now universally admitted; but it is also true that the lesions which cause objective symptoms in the domain of motion and sensation need not cause mental derangement, and also that lesions which cause mental derangement need not manifest themselves in any discoverable disorders of sensation or motion. In fact, for purposes of ideation we have practically two brains; for, though motion and sensation will be paralysed on the opposite side by destruction of one hemisphere, yet intelligence and thought are possible through the hemisphere which remains.

Various forms of lesion have been found in the brains of the insane, including morbid conditions as to vascularity, degeneration of the blood-vessels, and degeneration of the nerve-cells, neuroglia, and membranes; but no constant relation has as yet been established between any one form of degeneration and any one form of mental alienation, or between the latter and any localised lesion. Nor has it been clearly established whether the forms of degeneration found in the brains of the chronically insane are the result or the cause of the mental disorders. An exception, however, is to be made in favour of general paralysis of the insane, where there seems to be a definite connexion between the anatomical lesion and the symptoms manifested. In this disease we find as a constant, if not the only factor, a form of chronic encephalitis, affecting chiefly the cortical regions which physiological experiment has shown to be the motor zone of the hemispheres. This lesion is associated with progressive motor paralysis, varied with intercurrent epileptiform and apoplectiform seizures, and with mental symptoms characterised generally by exalted ideas and delusions as to wealth, power, and grandeur. The motor symptoms are readily accounted for by the locality and character of the cerebral lesion, but the relation between this and the mental symptoms is a subject which psychological analysis has yet to elucidate.

The objective symptoms of cortical lesions depend on their locality, and on whether they exercise an irritative or destructive influence on the parts they invade. From the localisation point of view alone the intimate nature of the morbid process is unimportant, except in so far as its irritative or destructive character is concerned. Lesions, such as tumours, which from their very nature exercise important indirect effects on the encephalon as a whole, apart from their effects on the regions which they directly invade, can rarely be exactly localised, owing to the difficulty of separating the direct and indirect symptoms from each other and referring each to its exact cause. Also no rigid conclusions as regards localisation can be drawn from morbid affections of the hemispheres which extend over a large area, such as the various forms of meningitis and meningo-encephalitis. In all these cases the nature of the affection must be diagnosed from its own general and special characters; its position and extent in the brain being arrived at approximately from a consideration of the effects of accurately circumscribed lesions, as determined by careful clinical and pathological observation and physiological experiment.

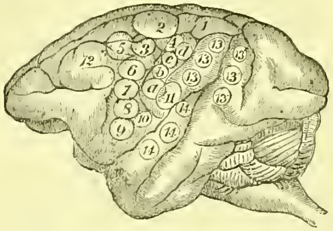

Fig. 30.—Side view of the Left Hemisphere of the Monkey. The areas have the same signification as in the next figure.

The brain may be considered as divided into a *motor* and a *sensory* zone.

Motor Zone.—The motor zone includes the convolutions bounding the fissure of Rolando, viz. the ascending frontal (precentral), the ascending parietal (post-central), and postero-parietal lobule, the base of the three frontal convolutions, and the internal or mesial aspect of the same convolutions, or marginal gyrus. In this zone are differentiated centres for the movements of the trunk, limbs, head, and eyes, and those of the mouth, tongue, larynx, and correlated muscles. The centres of the lower limb are situated at the upper extremity of the central convolutions and in the paracentral lobule or posterior part of the marginal convolution (numerals 1 and 2, figs. 30 and 31). The centres for the foot and toes are more especially posterior to the upper end of the fissure of Rolando; those of the thigh and leg anterior to the upper extremity of the same fissure. The centre for the arm is situated below that of the leg, and partly in front of it, and occupies the middle third, or rather two-fourths of the central convolutions (3, 4, 5, 6, 7, *a*, *b*, *c*, *d*, figs. 30 and 31). In this area may be differentiated centres for the upper arm (protraction), (5, figs. 30 and 31), and retraction (4, figs. 30 and 31); movements of the forearm, viz. flexion, supination, &c. (6, figs. 30 and 31); and those of the wrist, fingers, and thumb (*a*, *b*, *c*, *d*, 30 and 31).

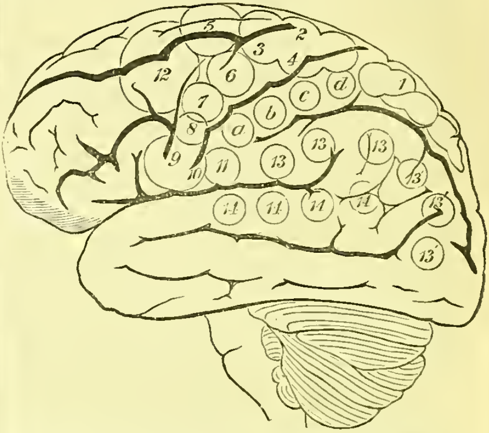

Fig. 31.—Side view of the Left Hemisphere in Man, with the areas of the cerebral convolutions. The effects of stimulation of each area, as ascertained by experiments on the brain of the monkey, are subjoined.

1, 2 (at the upper extremity of the fissure of Rolando). Movements of the foot and leg.

3, 4. Complex movements of the opposite leg and arm, and of the trunk, as in swimming.

a, *b*, *c*, *d*. Ascending parietal convolution. Individual and combined movements of the fingers and wrist of the opposite hand.

5. Posterior extremity of the superior frontal convolution. Extension forward of the opposite arm and hand.

6. Upper part of ascending frontal convolution. Supination and flexion of the opposite forearm.

7. Median portion of ascending frontal convolution. Retraction and elevation of the opposite angle of the mouth.

8. Lower part of the ascending frontal convolution. Elevation of *ala nasi* and upper lip, with depression of lower lip.

9 and 10. Inferior extremity of ascending frontal convolution (Broca's convolution). Movements of the mouth, tongue and larynx. Action bilateral.

11. Between the inferior extremities of the ascending frontal and the ascending parietal convolutions. Retraction of the opposite angle of the mouth; and the head turned slightly to one side.

12. Posterior portions of superior and middle frontal convolutions. Eyes opened widely; pupils dilated; head and eyes turned towards opposite side.

13 and 13′. Supra-marginal lobule, angular gyrus, and occipital lobe. Eyes moved towards the opposite side, with an upward (13) or a downward (13′) deviation. The pupils generally contracted. (Centre of vision.)

14. Infra-marginal (superior temporo-sphenoidal) convolution. Pricking of opposite ear; head and eyes turned to opposite side; pupils largely dilated. (Centre of hearing.)

The proximal movements of the upper extremity are represented most in the upper part of this area; the distal movements, that is those of the finger and thumb, most at the lower part. Below the arm area, and occupying the lower third of the central convolutions, is the centre for the movements of the face, mouth, and tongue and larynx, &c. (7, 8, 9, 10, 11). The upper facial movements are centralised more particularly in front of 7, 8 (figs. 30 and 31), and those of the platysma behind the fissure of Rolando (11, figs. 30 and 31). The movements of the mouth, tongue, and larynx are represented more particularly at the lower part of this area (9, 10, figs. 30 and 31). The centres for the adduction of the vocal cords are situated more particularly at the lower portion of the ascending frontal convolution, immediately posterior to the precentral sulcus. The centres for the lateral movements of the head and eyes are situated at the base of the frontal convolutions (figs. 30 and 31). The areas or centres for the head and eyes, arm and leg, extend over the margin of the hemisphere into the mesial aspect or marginal convolution. In this convolution, posterior to the centres for the head and eyes, and arm, are centralised the movements of the trunk, and, behind these, those of the leg. The prefrontal area, that is to say the region in advance of the anterior extremity of the precentral sulcus, though anatomically related to the motor tracts of the internal capsule, is a so-called non-excitable area—that is to say, it gives no outward response to electrical stimulation like the centres above described.

Irritative lesions of the motor zone proper, such as may be induced by syphilitic lesions, tumours, spicula of bone, depressed fractures, thickening of the membranes, &c., cause convulsions, which may remain limited to one limb, or one group of muscles, without loss of consciousness, or affect the whole of the opposite side with loss of consciousness, or become more or less bilateral with all the symptoms usually observed in so-called idiopathic epilepsy.

If the convulsive phenomena begin always in the same way, and if they frequently remain localised in one limb or one group of muscles, and especially if paralytic symptoms manifest themselves, the exact position of the lesion in the opposite hemisphere may be accurately diagnosed.

Destructive lesions of the motor zone cause general or limited paralysis of voluntary motion in the opposite side of the body, according as the lesion affects the whole of the motor zone, or is limited to special centres within this area. The causes of destructive lesions of the cortex may be various—hæmorrhage, laceration by wounds, &c. One of the most common causes is embolism or thrombosis of the arteries supplying the cortical motor area. These are derived from the Sylvian artery of the middle cerebral. The cortical branches may be occluded without interfering with the circulation in the corpus striatum, which is supplied by special branches, as shown by the researches of Duret and Heubner.

When the motor zone is affected by a general destructive lesion, complete hemiplegia of the opposite side results, in all respects like that resulting from destructive lesion of the corpus striatum and anterior portion of the internal capsule. In this form of paralysis the loss of motion is most marked in those movements which are most independent; hence the arm is more paralysed than the leg or face, and the hand more paralysed than the shoulder movements of the arm. This has been accounted for by the fact, that the centres for bilateral movements are intimately associated in the lower ganglia: hence the stimulus from one hemisphere can to a certain extent call forth the action of the conjoint motor nuclei. The electrical contractility and nutrition of the muscles is not affected by paralysis of cerebral origin. The nutrition of the muscles may, however, suffer from disuse, and frequently paralyses of cortical origin are followed after a time by rigidity and contracture, with descending sclerosis of the pyramidal tracts of the crura, pons, and lateral tracts of the spinal cord. In some cases the descending degeneration invades the anterior cornua of the spinal cord, and atrophy of the paralysed muscles ensues. Occasionally from limited lesions of the cortical motor area complete hemiplegia may occur on the opposite side, for the time at least. This is to be explained by the fact that sudden establishment of a destructive lesion may cause such commotion or perturbation of the centres in general, that their functions are for the time suspended. But in such cases those centres which have been only functionally suspended again resume their functions, and the paralysis disappears except of those movements the centres of which have been permanently damaged.

Limited lesions of the motor zone cause paralysis of those movements the centres of which the lesion invades. The result is not complete hemiplegia, but a *monoplegia* or *dissociated* paralysis. Hence, from a cortical lesion we may get a paralysis of the arm, or of the arm and face, or of the leg and arm, or of the face alone, or of the lateral movements of the head and eyes. If the leg is specially paralysed, the lesion is in the upper third of the central convolution; if the arm, in the middle third of the central convolution; if the face, in the lower third of the central convolution, and we may more precisely localise the lesion in the upper or lower half of these respectively, according as the proximal or distal movements are more particularly affected. The lesion which, while circumscribed at first, causes a monoplegia, may advance to other centres, and after a time produce general hemiplegia of the opposite side. Hemiplegia so resulting is a succession of monoplegiæ, and is a sure indication of cortical disease. It is to be noted that destructive lesion of the mouth-centre (Broca's region) on one side does not cause paralysis of articulation or phonation, owing to the fact that each centre has a more or less complete bilateral influence over the movements of the mouth and tongue and larynx. Destructive lesion of this centre in the left hemisphere generally gives rise to aphasia without paralysis of articulation (*see* APHASIA). In bilateral lesions there is both aphasia and paralysis of articulation (*see* Dr. Barlow's case, *Brit. Med. Journ.* 1877, vol. ii. p. 103). Limited cortical motor lesions are frequently associated with transitory rigidity of the opposite side of the body; and occasionally also with unilateral convulsions, owing to the morbid process inducing irritation of the neighbouring centres.

Unilateral destruction of the oculo-motor area causes a temporary conjugate deviation of the head and eyes to the side of lesion, a condition which is frequently seen in the early stages of hemiplegia, and it is due to the unantagonised action of the centre in the sound hemisphere. But the effects of unilateral destruction of this centre are not permanent, hence lesion of this region may appear entirely latent. Lesions of the prefrontal region cannot with certainty be diagnosed. Not infrequently they give rise to an irritable dementia; but it is difficult to distinguish this from the general symptoms of other forms of cerebral disease, such as tumour, abscess, and the like.

Subcortical lesions of the motor zone cause symptoms not readily, if at all, distinguishable from lesions of the cortex itself. They are perhaps less frequently quite limited, owing to the close relation of the various tracts converging towards the internal capsule, though occasionally they have the character of differentiated monoplegiæ. Theoretically, according to the results of experiment, irritative lesions of the medullary fibres should produce only tonic, and not clonic, epileptiform spasms of the related muscular groups; but, practically, this is not a reliable test, inasmuch as these lesions are apt to cause also cortical irritation and clonic convulsions of the usual type.

In the majority of instances of paralysis from disease of the cortex sensation has been unimpaired; but, on the other hand, a number of cases have been put on record in which, with lesions of various kinds (including tumours) implicating the motor zone, there has been paralysis, not only of motion, but also of sensation in a greater or less degree. But, whereas paralysis of motion is invariably caused by truly destructive lesions of the motor area, anæsthesia is only of occasional occurrence in connexion with apparently similar lesions. There is no relation between the extent, degree, or duration of the motor paralysis and the impairment of sensation; for there may be the most complete paralysis of motion with perfect sensibility in all its forms, cutaneous as well as muscular; and the motor paralysis may remain when the anæsthesia, if any, has entirely disappeared.

The centres of common and tactile sensibility have been shown by the writer's experiments, and those of Horsley and Schäfer, to be situated in the falciform or limbic lobe, and many of the recorded cases of anæsthesia in connexion with lesions affecting the motor zone can be shown to have directly implicated either this lobe or the sensory tracts of the internal capsule, and we may legitimately assume, even if we cannot demonstrate, a similar direct or indirect implication of these regions in the case of others. The slight degree of anæsthesia affecting the fingers more particularly which has been most frequently noted in connexion with cortical motor paralysis, is, in the writer's opinion, to be regarded as the beginning or the remnant of a general hemianæsthesia, due to direct or indirect implication of the sensory tracts.

Sensory Zone.—Experiments on monkeys and other animals, by the complemental methods of excitation and destruction, have shown that in the regions behind and below the motor zone there are differentiated centres for the senses of sight, hearing, common and tactile sensibility, smell, and taste.

The experiments of the writer indicate that the *visual centre* is situated in the angular gyrus and occipital lobe, or occipito-angular region; though those of Munk and Schäfer would limit this centre to the occipital lobe. Unilateral lesion of the angular gyrus, or occipital lobe, may remain latent; but if it is such as to cause extensive destruction of the medullary fibres of this region, homonymous hemianopia towards the opposite side is the result. This is particularly frequent in connexion with lesions invading the mesial aspect (cuneus) of the occipital lobe. Destructive lesions of the angular gyrus of the left hemisphere commonly cause word-blindness, and allied defects in visual ideation. Hemianopia may be caused also by lesion of the optic tract, or of the corpora geniculata. Uncomplicated hemianopia from cerebral lesion is comparatively rare. Usually it is associated with some degree of hemianæsthesia, owing to implication of the adjacent sensory tracts, or, it may be, with a greater or less degree of hemiplegia. In cerebral hemianopia, a pencil of light thrown on the anæsthetic side causes contraction of the pupils; whereas, if the lesion is in the optic tract no reaction occurs (Wilbrand's test). Irritative lesions of the angular gyrus not infrequently give rise to subjective ocular spectra, or visual hallucinations.

The *auditory centre* is situated mainly, if not exclusively, in the superior temporal gyrus. Owing to the bilateral relations of each centre, unilateral lesion may cause no appreciable symptoms. If, however, the lesion is in the superior temporal gyrus of the left hemisphere, word-deafness is usually met with. This does not occur in connexion with lesion of any other part of the temporal lobe, provided that the superior temporal gyrus is intact. Deafness from cerebral disease is very rare. In order that this should occur, it is necessary that the superior temporal gyrus should be destroyed on both sides. There are only two cases on record of such a bilateral lesion; one reported by Shaw (*Archives of Medicine*, February, 1882), and another by Wernicke and Friedländer (*Fortsch. d. Med.*, March, 1883). In both cases total deafness was observed. In monkeys, however, complete destruction of this region on both sides does not entirely abolish sensitiveness to sonorous vibrations (*Croonian Lectures on Cerebral Localisation*, Ferrier, 1890). There are several cases on record of irritative lesions of this region causing subjective auditory sensations, or epilepsy ushered in by an auditory aura (*ibid*).

The *centre of tactile and common sensibility* is situated in the falciform or limbic lobe, as above mentioned (gyrus fornicatus and gyrus hippocampi). This conclusion is founded almost entirely on the results of experiments on monkeys. Pathological evidence in favour of the localisation of the tactile centre in this region is as yet scanty.

Experiments on monkeys indicate that the centres of smell and taste are situated in close relation to each other at the lower extremity of the temporal lobe, or region of the hippocampal lobule (see *Croonian Lectures*, *sup. cit.*)

The anatomical relations of the olfactory tract, as well as the results of electrical stimulation, indicate that the *olfactory centre* is chiefly in relation with the nostril on the same side, and cases have been reported in which smell has been affected on the same side as the cerebral lesion. But the facts of cerebral hemianæsthesia, functional and organic, indicate that some at least of the olfactory tracts pass into the opposite hemisphere by way of the internal capsule. It was supposed by Meynert that the olfactory tracts decussate in the anterior commissure, but this is opposed by the anatomical and experimental investigations of von Gudden and Ganser. There are several cases on record of subjective olfactory sensation in connexion with tumours and other irritative lesions implicating the region of the uncinate gyrus in man (Jackson and Beevor, *Brain*, October, 1889). The exact position of the *centres of taste* has not been determined either by experimental research or by clinical observation, but the evidence is in favour of their being situated in close relation to those of smell.

Treatment.—The principles of localisation above indicated, combined with those of antiseptic surgery, have in recent years been in several instances successfully applied to the treatment of certain forms of cerebral disease otherwise hopeless ('Cerebral Localisation in its Practical Relations,' Ferrier, *Brain*, 1889; and *ibid.*, Mills). These include traumatic cysts and extravasations, the position of which has been determined by the symptoms, as well as cases of tumour and abscess, the last more particularly in connexion with disease of the middle ear. Excisions of irritable portions of the cortex have also been undertaken for the cure of focal epilepsy; in some instances with benefit, though in others without material improvement.

Up to the month of December, 1889, eighteen cases of cerebral tumour had been operated upon. Of these, seven were successfully removed. Of the remaining eleven cases (including three cases of tumour of the cerebellum, and five of unremovable tumours, two of them operated on *in extremis*) nine have died from various causes, including septic inflammation, cerebral œdema, or shock. This gives a mortality of fifty per cent. Contrasted with the latest statistics of trephining for all causes, or of the mortality from the major operations in surgery, we have reason to regard the surgical treatment of cerebral tumour as having achieved an encouraging measure of success, and probably greater successes may be attained in future when the conditions of successful operation and after-treatment have become better known. In the absence of definite indications as to the character of the tumour, and as to whether it is situated on, in, or beneath the cortex, trephining is, in the writer's opinion, justifiable as a diagnostic measure; for if the tumour should, after all, not be removable, the risks of the operation itself are less than the evil of allowing a case to perish which the autopsy might prove to be one which could have been dealt with successfully.

D. Ferrier.

CONVULSIONS.—Synon.: Eclampsia; Fr. *Convulsions*; Ger. *Krampfen*.

Definition.—This term is commonly given to more or less general, purposeless muscular contractions, occurring simultaneously and successively for a variable time—constituting a 'fit' of this or that kind. It is also, however, applied at times to certain more localised purposeless contractions, though these would be more appropriately (and are in the majority of cases) termed *spasms*. The latter, like convulsions, are of two kinds, *tonic* and *clonic*.

Classifications.—Convulsions have been variously classified by different authors according to the different points of view from which they have been regarded. From the point of view of their causation, it was the custom of older writers to recognise both a clinical and a physiological division into classes. From the former standpoint there was the division into (1) primary or essential; (2) sympathetic; and (3) symptomatic: whilst from the physiological point of view convulsions were divided into (1) centric; and (2) excentric. These classifications are altogether arbitrary and superficial, and will not stand the test of a critical examination—though the first of them is to a certain extent useful. Again, looking to the distribution of the convulsions, or to the parts involved, the classification that has been adopted by various writers may be summarised as follows:—(1) *external convulsions—a*, general; *b*, unilateral; *c*, partial; (2) *internal convulsions.*

These various terms need little explanation, though before referring to a more recent and more strictly scientific classification something requires to be said in regard to them.

Convulsions are termed *primary* or *essential* when they occur either without assignable cause, from mental or moral perturbations, or as a result of some local irritation. They are called *sympathetic* when the convulsions declare themselves as a prelude to, or in the course of, any of the specific fevers, as a consequence of acute pulmonary or renal affections, or in association with disordered states or structural diseases of any of the organs of the body other than those of the nervous system; while the name *symptomatic* has been applied to the convulsions which occur as a result of injury or structural disease of the nervous system itself. The unilateral convulsions which affect one half of the body only, as well as other more partial convulsions, are almost entirely confined to this latter group, though general convulsions of the symptomatic type are perhaps just as frequently met with. The so-called *internal convulsions* constitute an ill-defined group, the members of which are scarcely worthy of the name of convulsions at all. They are rather tonic or clonic spasms of particular parts. The best-known member of this group is laryngismus stridulus; but another example is a spasmodic and frequently recurring hiccup. Some authors would also include angina pectoris.

Convulsions, either tonic or clonic, or both, enter into or form the semeiological basis of six principal diseases having separate places in our nosology. These are *eclampsia*, *epilepsy*, *tetanus*, *laryngismus stridulus*, *hydrophobia*, and *chorea*. All but the first of these conditions will be considered in their respective places, so that eclampsia alone remains. But eclampsia and convulsions are convertible terms, meaning almost absolutely the same thing. The former term, indeed, is useless except for the mere purpose of literary precision. In epilepsy and in eclampsia we have equally to do with convulsions, which are now admitted by almost all modern writers to be, so far as the form of the attack is concerned, indistinguishable from one another. The former name, however, is given to convulsions which have a known tendency to recur at variable intervals; whilst the latter has been commonly applied to convulsions which are either solitary or, if not exactly so, which occur as a closely successive cluster or group, more or less distinctly sympathetic with some general or local bodily condition. Seeing that there is, in a very large number of cases, almost nothing in the nature of the attack itself to enable a medical man, called to a patient in convulsions for the first time, to say whether he has to do with an attack which will be repeated or not, it is easy to understand that eclampsia is a word more frequently to be seen in books than to be heard at the bedside. In books we may read of eclampsia neonatorum, the eclampsia of parturient women, and uræmic eclampsia; though the more common clinical equivalents are infantile convulsions, puerperal convulsions, and uræmic convulsions. The distinction between epilepsy and eclampsia is, therefore, one which is to a very great extent purely artificial, from the point of view of the convulsions themselves.

Convulsions have a frequent though less constant relationship also with many other affections, such as general paralysis of the insane, tubercular meningitis, chronic hydrocephalus, hemiplegia, and hysteria.

The more recent classification of convulsions, previously referred to, is that of Dr. Hughlings Jackson (*Brit. Med. Journ.*, vol. i. 1890). This is an attempt in the right direction—an attempt, that is, to identify the intimate cause of the phenomena, and to range convulsions into different classes according to the different portions of the brain which are the seats of the initial morbid processes in this or that form of the disease. He recognises three kinds of convulsion; each kind including several varieties; and these varieties again comprehending 'fits' of many different degrees of severity. The *first* kind or class corresponds with epilepsy proper, and these attacks are dependent, as he thinks, upon discharges of nerve-elements occurring in some portion of the cortex of the prefrontal lobe; the *second* kind or class comprises what are known as epileptiform attacks (epileptic hemiplegia or Jacksonian epilepsy), due to discharges commencing in this or that portion of the cortex of the so-called 'motor area' (Rolandic region) of the cortex; whilst the *third* kind or class comprises what he terms 'ponto-bulbar fits,' being due, as he thinks, to initial discharges of nerve-elements occurring in some part of the pons, the bulb, or (much more rarely) the spinal cord.

The aim of this classification is essentially scientific, but even its main divisions are based to a very large extent not so much upon well-ascertained facts as upon hypothesis and speculation. This is especially the case, as Dr. Hughlings Jackson admits, in regard to the convulsions belonging to the first and third classes; though the pathology of the second class—to a very large extent as the result of his labours—stands upon a much firmer basis of actual knowledge. Some kinds of eclampsia would fall into the first class, whilst many others would belong rather to the third class. It is difficult to say into which category well-developed hystero-epileptic attacks should be placed. It must not be lost sight of, moreover, that the conceptions which have inspired this classification are eminently hypothetical and speculative, however ably and consistently they may have been worked out; so that our notions as to the mode of production of fits, and as to the natural groups into which they are to be ranged, should still be regarded as being in a very rudimentary stage.

Ætiology.—The causes of convulsions are oftentimes more than usually complex, constituting a web of conditions partly made up (*a*) of predisposing, partly (*b*) of exciting, and partly (*c*) of proximate elements. It is often the fashion to pick out some one of the most prominent or easily recognisable of these factors, and speak of it as 'the cause' of the attack. It must never be forgotten, however, that this so-called cause, in any given case, may be able to act as such only when in conjunction with certain other more obscure, though perhaps not less potent, co-operating conditions.

The question of the causation of convulsions resolves itself into a strictly clinical and a strictly physiological department. It is one thing for the medical man to ascertain what are the particular individual states, conditions of life, and occurrences, physical or moral, which have contributed to induce an attack of convulsions. It is quite a different problem when he endeavours to unravel, by physiologico-anatomical data, the actual mode of production of the convulsions. For the present this is a point of view which concerns us less than the more strictly clinical side of the inquiry.

Predisposing causes.—One of the most important of these is the existence of an unduly excitable nervous system—one in which there is an exaltation of the tendency to produce reflex movements. This is a state of things which is often more marked in women than in men, and is also notably prominent in young children of both sexes. It is, moreover, much exaggerated in some children of nervous habit, who, besides being unduly emotional or excitable, are very prone to start or tremble at the least noise, and are subject to muscular twitchings in various parts of the body. With increasing age, and more especially in the male sex, we find the sensorial and emotional nerve-centres becoming less excitable.

In persons possessing a nervous system of this type there is a lack of proper balance or equilibrium between the functional activities of some of its parts; and there seems to be an undue tendency to errors of nutrition whereby the matter of its nerve-cells becomes from time to time highly unstable and prone to undergo 'discharges' of a morbid character.

The predisposing groundwork being of this nature, how is it caused or to be accounted for? (1) It may be inherited from parents, or from grandparents, who may themselves have possessed a nervous system of this type, and may have been subject to fits or other well-marked disease of the nervous system. But though not inherited in the strict sense of the term, it may (2) be connate: the patient may always (*i.e.* from birth) have possessed a nervous system of this type, as an accompaniment of the mere low vitality which is often seen in children born from parents who are weak or aged and debilitated. (3) At other times the nervous system may have acquired such predisposing characters some time during the life of the individual (especially during childhood or adolescence) owing to the action of various sets of conditions, such as—(*a*) the cachexia which occasionally follows measles, pertussis, &c.; (*b*) insufficient or improper food; (*c*) chronic diarrhœa; (*d*) hæmorrhages or exhausting discharges.

If we turn now to the various *exciting causes*, we find these powerfully influenced by the periods of age, which we may conveniently, though artificially, mark off from one another.

Infancy (from birth to end of 2nd year).—In certain cases convulsive attacks are congenital; and here perhaps the most frequent exciting cause is a meningeal effusion of blood which irritates the surface of the brain—the extravasation having been occasioned during parturition. These congenital attacks are most frequently associated either with more or less marked hemiplegia, or with a subsequent partial or distinct condition of amentia or idiocy. Such unfortunate infants may continue quite unable to stand or even sit up; they remain unable to speak, and, as in a case seen by the writer, the child may be quite blind. Meningeal or superficial hæmorrhages may also occur in young infants, under the strain produced by violent fits of coughing; and in some of these cases such effusion may be followed by convulsions. Fits in infancy may also follow falls or blows upon the head.

In infancy, again, convulsions may usher in or supervene in almost any acute disease, this being especially the case in the exanthemata; in pneumonia or bronchitis; and also in tubercular meningitis.

But, still more frequently, convulsions in infancy are excited by mere peripheral irritations, as during the process of teething, from an overloaded stomach, or from indigestible food. Diarrhœa and worms also take their place as more or less frequent excitants of convulsive paroxysms in infants, though worms only begin to appear towards the end of this period. But though irritations in the field of distribution of the fifth and pneumogastric nerves are especially potent in exciting convulsions, irritations of other parts of the body may also lead to similar results, whether they are occasioned by the injudicious disposition of pins, by tight strings wounding or irritating the skin of the body, or by any other means. The more distinctly that predisposing conditions exist, the more frequently will any or all of these exciting causes give rise to an attack of convulsions.

Lastly, an infant which has taken the breast of a woman who has shortly before been much perturbed by violent anger, grief, or any other strong emotion, may thereafter, if predisposed, be seized with convulsions—probably owing to the milk of the nurse having been so altered in quality as to have led to gastric trouble and irritation in the infant.

Childhood (from the 2nd to the 13th year). Most of those exciting causes which are influential during the previous period continue to be occasionally operative in this—especially during the first half of it. Meningeal hæmorrhages are now rarer, though they may still occur during violent paroxysms of coughing, and also from falls or blows upon the head. The latter causes of hæmorrhage may, however, act in producing fits in other ways, *e.g.* by concussion, shock, &c., and they now come to be more frequently operative. The exanthemata are still apt to be preceded or associated with convulsive attacks; and irritations, especially from teething or irritants (undigested food or worms) in the intestinal canal, are also occasionally prone to be followed by such a sequence.

During this period another cause comes into operation with great frequency, and this is fright. The first fit either follows the fright more or less immediately, or it may not take place for days, or perhaps for weeks. During the interval, however, the health and mental condition of the child is generally obviously disturbed. Proper treatment at this stage may prevent the occurrence of fits. Scrofulous or other tumours in the brain sometimes help to determine convulsions in children.

Adolescence (from the 13th to the 20th year).—Fright or other sudden emotions, falls upon or blows about the head, still appear as frequent excitors of convulsive attacks which recur (epilepsy) at this period of life, though meningeal hæmorrhages, acute diseases, and peripheral irritations are much less frequently operative than at earlier periods, since the special irritability of the nervous system characteristic of childhood decidedly abates during these years.

Other and new causes, however, come into play at this epoch. The establishment of puberty is a kind of crisis during which, independently of all other causes, convulsions or fits may be initiated in those whose nervous systems are at all predisposed towards such an occurrence. This is more especially so in the case of the female, partly because of the existence of a rather more frequent predisposition in persons of this sex, and partly because of extra excitations in association with the establishment of the catamenia. Ovarian or uterine irritation, or irregularity of the functions of these organs at this period, may occasion fits which may take an hysterical type. Masturbation may also be added as an occasional provocative of epilepsy at this critical period of life, though the writer is inclined to think too much stress is often laid upon this as a cause. This mode of causation occurs more frequently with the male sex.

Excessive study and mental application, as well as worry or anxiety, must also undoubtedly be enumerated among the causes of epilepsy at this period of life.

Neither must we forget the possible existence of aneurysms of the cerebral arteries, or of morbid growths in connexion with some portion of the brain or its meninges. This latter cause also figures in earlier periods of life—more especially in those children who are of a scrofulous type. And in some of such cases the new-growth may lead to the supervention of chronic hydrocephalus, and thus render the occurrence of convulsions even still more likely.

Early adult age (20-40 years).—Fits originate much less frequently during this period of life than in adolescence or childhood. They are, however, apt to supervene, more especially when the general health is lowered, under the influence of various exciting causes. Grief and mental worry (particularly when combined with long-continued bad sleep), and the labours or cares of business, are then apt to induce them.

Blows or falls upon the head may still be followed by attacks of this kind, though perhaps with less frequency than in the earlier periods of life.

Syphilitic indurations or growths from the meninges may now occur; and other attacks (often of one-sided convulsion) may be determined by various pathological changes or accidents taking place in regions of the brain where more severe lesions would give rise to hemiplegia. The primary change in these cases may be minute hæmorrhages into the brain-substance, or minute and slight softenings produced by blocking of small vessels (embolism or thrombosis). With lesions of this kind hemiplegia and convulsions are often more or less associated. Occasionally the cause may be a non-syphilitic tumour, occupying the side or base of the brain.

Puerperal convulsions in the female, and uræmic convulsions in both sexes, are most frequently met with during this period. During pregnancy the excitability of the nervous system is often greatly increased, and in the production of puerperal convulsions some amount of uræmia also intervenes not infrequently. Intemperate habits, carried to excess, frequently produce fits, and so also may venereal excesses.

After middle age (40 years and onwards). The excitability of the nervous system diminishes, so that epileptic attacks commence with much less frequency at this period. At the climacteric this excitability is temporarily increased, and fits again become more frequent, under slight exciting causes.

Although fits are only very rarely liable to be induced by the sequelæ of hæmorrhages or of occlusions of cerebral vessels, yet these events now grow more common as age advances, and are therefore to an almost corresponding extent more liable to figure as causes of convulsive attacks. An attack of hæmorrhage or of softening may be ushered in by epileptiform convulsions (especially when the lesion occurs in certain parts of the brain), and in some cases such attacks may thereafter recur at irregular intervals. Exposure to great heat, or sunstroke, may also at this period, or earlier, act as the exciting cause of convulsions.

Mental overwork, worry, fright, and suchlike influences, are much less likely to operate in persons over 40 than in earlier life; and the same is to be said of blows or injuries of the head, short of the most severe, causing actual lesions of the brain. But the malnutrition and degeneration induced by intemperate habits may predispose to symptoms of this kind; and so also may blood-poisoning from renal disease, which is often present.

Various organic diseases of the brain, whether principally characterised by degenerations with a process of more or less general atrophy, or with localised overgrowth of connective tissue, are also not infrequently productive of convulsions, either in persons of middle or of advanced age. A well-marked instance of the former of these associations is to be met with in general paralysis of the insane. Cysticerci on the surface of the brain have also been the cause of most obstinately recurring convulsions.

Lastly, it should always be borne in mind that convulsions are sometimes the result of the action of poisons of various kinds upon persons of any age. Occasionally such poisoning may be brought about by articles of diet, such as mussels or fish in certain states, or poisonous mushrooms; whilst at other times it results from some of the well-known narcotico-irritant poisons, taken either inadvertently or purposely.

Anatomical Characters.—These may be said, so far as our present knowledge goes, to be absent. It is true that general or partial congestion of the brain may frequently be encountered in those who die during an attack of convulsions. But this congestion is to be regarded as a result rather than as a cause of the fit. The convulsions are due to mere molecular changes in the brain, inappreciable to, or at all events unappreciated as yet by, the most skilled microscopists. When fits occur in association with actual organic growths or other lesions of the cerebral cortex or elsewhere, some of the nerve-cells contiguous to such lesions may have their nutrition so altered as to form occasional starting-points for nervous discharges, which descend so as to upset the equilibrium of certain unstable or highly charged motor centres (ponto-cerebellar) in such ways as to determine the convulsive phenomena. But a similar disturbance of nervous equilibrium with discharge of motor energy, immediately productive of convulsive phenomena, may result, in another case, from abnormal visceral impressions (induced, it may be, by indigestible matters in the intestine, or by an acute disease of the lungs), or from some surface-irritation. In accordance with this point of view, such organic growths or other lesions as may be found in the brains of epileptic patients need receive no further mention here. Those who may be inclined to think otherwise, should bear in mind the fact that convulsive attacks are easily produced in animals from whom the cerebral hemispheres have been removed. It should always be borne in mind, however, that there is one region in particular of the cerebral cortex, viz. the so-called Rolandic area (comprising the convolutions which bound the fissure of Rolando), the irritation of which by new-growths or other organic lesions is specially prone to give rise to unilateral convulsions, whose characteristics are in many respects extremely well-defined ('Jacksonian epilepsy').

Symptoms. — The varied nature of the causes makes it impossible to say anything of moderate compass concerning the premonitory signs or symptoms which may precede an outbreak of convulsions. These must necessarily vary immensely in different cases. Some of the characters of the predisposing state have been already alluded to. The onset is, however, often abrupt, and without any distinct premonitory symptoms.

With regard to the actual characters of the attack, it will be sufficient to say here that they also vary extremely in different cases; and as, notwithstanding this great variability, it is impossible in any individual case to tell, from the nature of a first convulsive fit, whether it will form a more or less isolated attack, or whether it will constitute one of a subsequently recurring series, the reader may, for this part of the subject, be referred to the description of the different forms of the attack given under EPILEPSY. All that is there said concerning the actual phenomena and mechanism of the attacks, holds good for occasional convulsions as well as for those which are habitual. In each well-marked attack we have to do with (1) a more or less distinct stage of tonic spasm, followed (2) by one of clonic spasms, and (3) succeeded by a state of stupor. One or other of such stages is, however, not infrequently more or less abortive. Convulsive attacks may, at times, so rapidly follow one another as to be merged into one long series or *status convulsivus*, differing in no respect from the analogous *status epilepticus*.

COMPLICATIONS AND SEQUELÆ.—The complications of convulsions are most various, seeing that in different cases we may have to do with irritated gums, repletion, diarrhœa, worms, or an acute specific disease; whilst in other cases the causal complicating conditions may be general debility and sleeplessness, mental anxiety, puberty, or the climacteric period. Again, in other cases, either pneumonia, renal disease, pregnancy, ovaritis, or some organic brain-disease may be the accompanying condition.

The nature of the sequelæ will depend principally upon the frequency of the attacks, and the duration of the period during which the patient has been subject to the recurrence of them, so that for this part of the subject the reader may refer to the article EPILEPSY.

DIAGNOSIS.—There is very little difficulty in regard to the diagnosis of convulsions. The differential characters of laryngismus stridulus are given elsewhere, and the absence of any real distinction between a fit of eclampsia and a fit of epilepsy has already been insisted upon. Neither of these affections can be easily confounded with certain forms of chorea, which occasionally present themselves in adults, with movements not unlike those of ordinary convulsions. The more continuous nature of the movements, and the fact that consciousness is not impaired, suffice to distinguish all forms of chorea. The spasms of tetanus and hydrophobia are also easily distinguishable from an ordinary attack of convulsions.

The characteristics of hysterical convulsions are pointed out in the article HYSTERIA.

The real difficulties from the point of view of diagnosis have reference to the cause of the attack. To arrive at a decision in regard to this is often very difficult, and occasionally impossible—at all events when a patient first comes under observation. At other times, however, the indications are so plain that there can be little or no difficulty. It is a question which should always be considered with the utmost care, since on the correctness of our conclusions in regard to this point the efficacy of the particular line of treatment which we adopt must necessarily depend. Nothing is more to be deprecated than hasty jumping at conclusions, from mere routine and superficial considerations. The condition of the patient must be carefully examined, and the nurse, attendants, or relatives must be closely questioned in order that we may learn as much as possible as to the previous state of health of the patient, and more especially as to the time and events which immediately preceded the first outbreak of an attack of convulsions. Examination and inquiries combined may convince us that the convulsions are (1) of the primary or idiopathic variety, immediately occasioned perhaps by fright, anxiety, overwork, overmuch or indigestible food, &c.; or we may come to the conclusion that the convulsions are (2) of the sympathetic order, dependent upon pregnancy, renal disease, the onset of an acute specific fever or of pneumonia, or due to the existence of whooping-cough, scarlet fever, &c. Or, in the absence of reasons for placing them in either of these categories, we may be forced to conclude that they are (3) symptomatic of some organic brain-disease, the nature of which must then be determined as nearly as possible, judging from the age of the patient, the mode of onset of the attacks, his present state and associated conditions.

In any case we may have to inquire more closely as to the hereditary tendencies, or acquired predisposing causes, which sometimes reduce the nervous system to such a degree of excitability, or disturbed equilibrium of certain parts, as to lead to an attack of convulsions without the aid of any obvious exciting cause. In infants or very young children such a condition of the nervous system may display itself by great restlessness and startings at night, by the child's sleeping with half-open eyes, by drawing in of the thumbs across the palms, by twitchings of the limbs, of the angles of the mouth, or of the facial muscles generally. In older children and in young adults the signs which most easily mark a similar below-par condition of the nervous system are twitching of the muscles about the angle of the mouth, and of the tongue (the former being specially well seen when the latter organ is tremulously protruded for inspection), associated with debility, anorexia, partial insomnia, and general nervousness. In nervous girls fits are induced by very slight causes about the time when the catamenia become first established. The indications for treatment must in fact vary immensely in any five or six consecutive cases of convulsions to which the practitioner may be summoned.

PROGNOSIS.—The possibilities under this head are at least six in number in regard to any case of convulsions:—(1) The patient may recover after having a single fit or a batch of them within a few hours or days, and may never have another attack. (2) The patient may recover, and though he or she may not have fits habitually thereafter, they may recur at prolonged intervals, whenever predisposing circumstances chance to be strong or are supplemented by an exciting cause of unusual potency. Thus convulsions during teething may cease, and may not recur till the constitution has been lowered by some illness years after, or when the nervous system has been rendered more irritable, as at the time when the catamenia are about to commence, especially if then some slight fright should also come into operation as an exciting cause. (3) The patient may recover, though he subsequently continues to have fits either at irregular or regular intervals; he becomes, in short, a confirmed epileptic. (4) The convulsions may come to be followed by temporary delirium or a more or less marked maniacal condition, recurring after all or some seizures. (5) The patient may recover from the convulsive attack and may or may not have another fit, though he may remain hemiplegic. (6) The patient may die during the attack or almost immediately afterwards—(*a*) from the effects of it, or (*b*) by reason of some organic lesion by which the fit itself has been determined.

Recoveries are fortunately the rule, but death, especially in infants, is by no means uncommon. We possess no accurate data to enable us to assign the numerical proportion of these terminations to one another or to the other above-mentioned sequences.

Treatment.—During the convulsion itself, whether we have to do with an infant or an adult, we must see that all clothes are thoroughly loose about the neck and chest, and the patient should be placed in the supine position with the head slightly raised. Beyond seeing that the patient does not knock or injure himself, owing to the violence of his movements, these should not be much restrained; although efforts should always be made to prevent the tongue being bitten, by slipping the most suitable thing at hand between the molar teeth on one side, when the age of the patient or the character of the fit renders it likely that this event might otherwise occur. Beyond such simple measures as these, the less we do during the actual continuance of the fit the better it will probably be for the patient. We know of no rational or successful means of cutting short an ordinary attack of convulsions, and in the face of such an attack we should be cautious how we interfere lest evil may be done.

Where we have to do with a succession of attacks quickly following one another, and which have already lasted some time, the injection into the rectum of chloral hydrate, with or without bromide of potassium, in suitable doses may be beneficial; or the careful administration of chloroform may be tried, as it is found very serviceable in many cases when a *status convulsivus* occurs in children or in adults—though it would not be desirable to have recourse to it in infants. Under similar circumstances, for the latter the warm bath may be substituted, and sometimes seems to do good. Antipyrin and antifebrin have also occasionally been given with benefit in cases where fits are succeeding one another rapidly, and such drugs are especially indicated in those cases where the temperature in the rectum rises rapidly to 103° F., or upwards.

On the cessation of the convulsion or convulsions, or during the intervals, the treatment to be adopted to prevent their recurrence must necessarily vary immensely according to the age of the patient, and according to the predisposing and exciting causes which appear to have been operative in inducing the attack.

An overloaded stomach will call for the speedy administration of an emetic; or where indigestible food has already passed into the intestine, an enema or brisk purgative should be given. Diarrhœa must be checked, or anthelmintics administered when worms are suspected. Gums may be lanced if they seem really to need it. In many of these cases an acquired or hereditary predisposition will have to be combated by the careful regulation of the diet, so that nutritious and easily digested food is to be given in place of their opposites, and at the same time the most suitable nervine tonics and antispasmodics.

For general usefulness in such cases no remedies can compare with the bromides of potassium, sodium, and ammonium. The former salt seems to be the most potent of the three; though if the bromide of sodium will check the fits, it is often more desirable to give it than the potassium salt. On the other hand, where the circulation is weak, or mental depression is apt to be induced, it is often best to administer bromide of ammonium. Sometimes the best results may be obtained by giving two of these salts in combination; at other times by administering moderate doses of chloral hydrate in combination with one or other of them. As part of the specific influence which these drugs exercise over nerve-tissue, they fortunately establish a tendency to quieter and sounder sleep, of which such patients often stand much in need. Ten-grain doses three times a day should be given at the commencement to youths or adults, and afterwards slightly increased if necessary. Or a larger dose may be given once a day, either in the morning or at night, or night and morning, according to the indications in each case.

Very large doses of these drugs are rarely beneficial, and may do harm (*see* Bromism). Their action often seems to be favoured and harmful symptoms warded off by combining with the bromides suitable doses of liquor arsenicalis and tincture of digitalis or of convallaria. Quinine or belladonna are other remedies which may also often be given simultaneously with great advantage. For young children or infants, the dose of the bromide must, of course, vary with their age.

Valerianate of zinc and oxide of zinc are mostly remedies of altogether less power, though these and other drugs may be tried where bromides appear to fail. Occasionally, too, good results may follow from the administration of borax in doses of fifteen or twenty grains three times a day, freely diluted and combined with liquor arsenicalis, where bromides only seem to aggravate the patient's condition, or, at least, to be powerless for good.

General treatment of this kind is applicable to a large proportion of cases also in which in debilitated or 'nervous' patients fits have been brought on by fright, worry, or anxiety, or by no assignable cause. Wherever the fits have recurred frequently, and a sort of habit has thus been established, such treatment has to be continued over long periods (one to three years or more), with suitable modifications, in order to stamp out the tendency to recurrence and thus effect a cure. In all such cases fatigue of mind and body is always to be avoided; a quiet and regular life, free from excitement, must be led; and in those instances in which over-attention to business or over-study has been in part operative in bringing on the fits, absolute rest must form an essential part of the treatment. In girls or young women in whom fits occur at the time of the establishment of the catamenia, or where they recur in association with an irregular menstrual function, the general health often requires our most careful attention, in addition to such measures as are above indicated.

The convulsions that belong to the class known as *sympathetic* have to be carefully considered in relation to the malady of which they are the forerunners or associates. When convulsions precede an attack of scarlet fever or of small-pox they usually subside of themselves as the disease develops. They are, however, of much more significance when occurring during the course or towards the close of one of these maladies, or during an attack of whooping-cough or of croup. Our indications for treatment must then be derived in the main from the general state of the patient, and this is also eminently the case where we have to do with uræmic convulsions.

The treatment of *symptomatic* convulsions, dependent upon actual organic brain-disease, must also necessarily be subordinated to that appropriate for the affection itself upon which such symptoms depend. No drug will be found more generally useful, however, than bromide of potassium in ten- to fifteen-grain doses for an adult (administered three times a day), in checking or diminishing the repetition of convulsions in these cases. Often here also the action of the bromide seems to be favoured by combining it with liquor arsenicalis and with moderate doses of digitalis, the latter being indicated especially in those cases in which there is great general nervousness in association with a disordered cardiac rhythm. Where sounder sleep is necessary, chloral hydrate, alone or in combination with bromide of potassium, should be given at bedtime. Sulphonal often has the desired effect. Tinctures of sumbul or of henbane are at times useful adjuvants.

Where we have to do with tumours of the brain, and especially with syphilitic growths in the meninges, much better results are to be hoped for from large and increasing doses of iodide of potassium (that is, x to xxx grains or more, three times a day), either alone or in combination with small doses of bichloride of mercury. With such drugs we should combine the administration of nutritious food, and attention to the improvement of the general health in every way that may be possible. Occasionally, both in these cases and in non-specific cortical growths and thickenings of the dura mater, the operation of trephining has been had recourse to with great benefit to the patient. In some instances a cortical growth, or a portion of cicatricial tissue or of thickened dura mater, has been excised, with the effect not only of curing previous pain and tenderness, but also of curing or greatly diminishing the frequency of epileptiform attacks to which such patients have been subject. The cases for which this treatment is suitable constitute, however, only a comparatively small percentage; and much judgment and knowledge are needed for the selection of those in which such surgical treatment is likely to prove beneficial. *See* BRAIN, Diseases of; EPILEPSY; and SPINAL CORD, Diseases of.

H. CHARLTON BASTIAN.

CO-ORDINATION.—This term is used in reference to muscular movements principally. Certain parts of the nervous system have more especially to do with the calling into activity, and therefore with combining, the contractions of different muscles, both simultaneously and in succession, in the precise order in which they occur in the several motor acts of which they are capable. The nervous arrangements upon which these actions depend have come into being, both in the race and in the individual, by processes of organic growth and development *pari passu* with the possibility of executing these several movements. It would be wrong to expect, therefore, that an isolated organ should exist solely for co-ordinating muscular movements. The execution of the most habitual of these must depend, to a large extent, upon the activity of the ordinary motor (and related sensory) tracts of the spinal cord and brain. The extent or precise mode in which the cerebellum intervenes in certain higher forms of co-ordination is still involved in much obscurity. That it has some share in such functions may be regarded as certain, though it probably intervenes far less than some would have us believe, who regard the cerebellum as *the* organ for the co-ordination of muscular movements.

Many nervous affections exist in which the co-ordination of muscular movements is more or less impaired. One of the most familiar of these is locomotor ataxy, a disease dependent upon a morbid process in the posterior columns of the cord. Sclerosis of the antero-lateral columns of the cord also not infrequently disturbs the execution of muscular movements, especially those of the upper extremities. Chorea gives rise to very similar uncertainties in the execution of muscular acts. Spasms of all kinds, in short, tend to interfere with the harmony of the muscular movements in the course of which they intervene. Stammering is an affection of this kind, implicating some of the muscles of articulation; and certain disturbed cardiac actions characterised by disordered rhythm can only be regarded as belonging to the same category.

The above-mentioned are common instances of impaired co-ordination of muscular movements dependent upon structural or functional changes in parts of the nervous system other than the cerebellum. Certain diseases of this organ, however, are known to give rise to a distinct form of inco-ordination. It is characterised by a reeling, unsteady gait in walking, with legs straggling, and mostly wide apart, to which the term 'titubation' is commonly applied. Other kinds of inco-ordination may hereafter be proved to depend upon diseases of the cerebellum. Its morbid conditions are still very imperfectly recognised, and this is especially true in regard to its merely functional perturbations.

Certain inco-ordinations in speech and writing are common. Instances are to be found in that use of wrong words or misapplication of terms which we meet with in aphasic and amnesic persons; also in the substitution of wrong words in the act of writing, or of wrong letters in the writing of words, when such substitution is mechanical and unintentional—and when it is wholly distinct, therefore, from mere inability to spell. These defects are inco-ordinations of a complex kind, dependent upon the perverted action of higher cerebral centres, in the same way that incoherent speech generally is dependent upon incoherent thought. There is reason to believe, indeed, that the same kind of ultimate defective nervous action which leads to inco-ordinations of movements when certain motor regions of the nervous system are affected, may, on the other hand, give rise to perverted perceptions (*illusions*) or to perverted thought (*incoherence*) when the disturbed nervous action occurs in other and in higher parts of the central nervous system.

H. Charlton Bastian.

COPHOSIS (κωφός, deaf).—Deafness. *See* Hearing, Disorders of.

COPPER, Poisoning by.—Synon.: Fr. *Empoisonnement par le Cuivre*; Ger. *Kupfervergiftung.*—*Metallic copper* may be regarded as innocuous when swallowed, and the recent researches of Hirt show that those who are engaged in the metallurgy and manufacture of copper utensils are not specially liable to any diseases which can be attributed to copper as such. It is, indeed, stated that workers in copper enjoy an immunity from cholera, a conclusion which is based on very insufficient premisses. It is contradicted by the occurrence of cholera among coppersmiths in Breslau in 1866, and by certain other cases of a like nature reported by Hirt. That the disease is seldom found among workers in copper is true, but that the copper has anything to do with this result is not proved.

Though pure copper may be regarded as innocuous, it is otherwise with *alloys of copper*, more particularly those with zinc and tin, known under the names of brass and bronze respectively, and with compounds of copper with lead or arsenic. In these the injurious agent would appear to be the alloy, and not the copper itself. An affection of a febrile character, and known as 'brass-founder's ague,' occasionally occurs on fusing days, and it is attributable to the zinc fumes which are generated by the melting process.

The *salts of copper*, on the other hand, are capable of causing injurious and fatal results. The more important salts, from a medico-legal point of view, are the sulphate, blue vitriol, or bluestone; the acetates (basic and neutral) constituting artificial verdigris; and the carbonate or natural verdigris. The manufacture of verdigris is carried on to a large extent in the South of France. Plates of copper are acted on by the skins of grapes, which are allowed to undergo the acetous fermentation. Those engaged in this industry on the whole enjoy good health, and it is only rarely that symptoms can be directly traced to the work; and then only when through sheer carelessness and uncleanliness quantities of the salt have been ingested. It is even said that dogs eat the refuse grape-skins without appearing to suffer from poisonous symptoms. On the other hand, symptoms of poisoning of a family have recently been recorded where they had eaten haricot beans, grown, as is the custom, between the vines, which latter had been watered with a solution of sulphate of copper (Raynaud, *Bull. Gén. de Thérap.*, 1888).

1. **Acute poisoning by copper.**—Symptoms.—The salts of copper, when taken in sufficient quantity, cause symptoms of acute poisoning, frequently terminating fatally.

Twelve to fifteen grains of the acetate have been sufficient to kill a dog within an hour. The fatal dose in man is not quite determined; but doses above the usual emetic dose of the sulphate (ten to fifteen grains) have caused serious symptoms, and death has resulted within four hours after swallowing some pieces of the sulphate. Starr (*Med. Record*, May 1882) records a case of death in four days from one ounce of the sulphate. Half an ounce would probably cause a fatal result. The symptoms are essentially those of irritant poisoning, namely, styptic or coppery taste, constriction of the fauces, epigastric pain, violent vomiting and purging, followed by collapse and death, usually with tetanic or convulsive symptoms. That which characterises copper-poisoning more especially, as compared with other irritants, is the frequent occurrence of jaundice. Hæmoglobinuria with albuminuria has also been observed (Starr's case). In dogs copper usually causes death with symptoms of paralysis of the hinder extremities, proceeding like a form of ascending paralysis, in addition to the usual irritant symptoms. It is said also to have a paralysing action on the heart. Such effects have only followed, at least constantly, introduction into the veins; when taken by the stomach most of it seems to be stopped by the liver, or in the case of some of the salts (*i.e.* acetate) may be reduced by the sugar of the food (Roger, *Revue de Médecine*, 1887, No. 11).

2. **Chronic poisoning by copper.**—It is generally stated that the long-continued introduction of copper into the system in small doses gives rise to a form of chronic poisoning known under the name of 'copper colic.'

Symptoms.—The symptoms are essentially those of gastro-intestinal irritation, with nausea or sickness and diarrhœa. They have none of the characters of colic in the sense in which the term is usually employed. The hair and the cutaneous secretions of workers in copper and brass are sometimes found of a green colour, and a line is sometimes found at the margin of the gums and teeth, variously described by authors—Corrigan calling it purple, while Clapton calls it green.

Though symptoms of gastro-intestinal irritation, as above described, have been found among workers in copper, the question is whether they are in reality due to the copper, or merely symptoms of a not uncommon affection showing themselves among copper-workers. That copper does gain access into the system, and may be detected in the urine during life, and found in the bones after death, without the individual showing any manifest symptoms during life, seems pretty well established. But though we may regard it as certain that symptoms of copper-poisoning are more rarely found than those of lead-poisoning among those who have to deal with these metals, yet it would be a very unwarrantable conclusion, and contrary to all that we know of the action of poisons, to assert that a substance which is undoubtedly poisonous can be taken freely into the system with impunity. This is a point of considerable interest in reference to the accidental or wilful adulteration of articles of food with copper salts. Many cases are on record of severe symptoms resulting from the use of copper utensils in cooking, or more frequently from the storage of water or articles of food in copper vessels, especially if the food contains oil—which, on turning rancid, dissolves the copper—or vegetable acids, or even large quantities of ordinary salt.

Copper salts are also employed intentionally to impart a green, fresh colour to pickles and preserved vegetables, such as peas. It is asserted that the quantity of copper necessary to produce this effect is infinitesimal, and that no poisonous effects can be proved to have resulted even from long-continued employment of these vegetables as articles of food. This is strongly maintained by M. Galippe, who has tried them on himself and family. Assuming the impossibility of proving the injurious effects of copper-tinted vegetables, the question comes to be principally a social and economic one, as to the propriety or legality of adulteration of food at all, and especially with a substance undoubtedly poisonous. Copper is said by Odling and Dupré to be a natural constituent of the human body. They have found it in the blood, tissues, viscera, and in many animal products, such as cheese, eggs, and also in many vegetables. It takes the place of iron in the blood colouring-matter of some invertebrates (cray-fish), and is found as a constituent of the colouring-matter of the feathers of the turaco (plantain-eater).

Diagnosis.—The greenish or bluish colour of the vomited matters, which turn bright blue on the addition of ammonia, renders the diagnosis comparatively easy.

Treatment.—In *acute* cases the stomach should be evacuated by encouraging vomiting, or by the stomach-pump. Albumen in some form, as milk or white-of-egg, should be given, in order to precipitate the copper. Iron filings may be given for a similar purpose.

In *chronic* poisoning the cause should be discovered and removed, or the individual removed from the cause. D. Ferrier.

CORN.—Synon.: *Clavus*; Fr. *Clou*; *Cor*; Ger. *Leichdorn*; *die Hühnerauge.*

Definition.—A corn is a thickening of the epidermis, caused by undue pressure and friction, as by boots, shoes, or implements of occupation. It is usually situated on a prominence, such as that of a joint, where the skin is subjected to double pressure and is therefore unable to yield, or between the toes. Corns are most common on the feet.

Description.—A corn usually begins as a general and uniform thickening of the epidermis, which is termed a *callosity* (*tyloma, tylosis, Schwielen*). Callosities may occur on any part of the integument. Thus they may occupy the prominence of a joint, or spread over the heel or the metatarsal cushion of the foot from pressure in walking, or occupy the metacarpal prominences of the hand, as in boatmen.

The callosity is composed of laminated epidermis; is thickest in the centre, becoming thin towards the circumference; and is more or less hard and condensed, smooth and hornlike in appearance, and yellowish in colour. When the irritation which gives rise to a callosity is prolonged, effusion is apt to take place beneath it, and it is raised like a blister, the effused fluid being sometimes serous and sometimes sero-purulent. Whenever this happens, the subsequent separation of the horny layer results in spontaneous cure.

When the pressure giving rise to a callosity, instead of being diffused, is concentrated on a central point, the epidermis corresponding with that point increases in thickness, by its under surface, and forms a conical prominence; further pressure increases the length and breadth of the cone, and in this way a corn is established. Continued irritation enlarges the corn by hyperplasia of epidermic cells, and its pressure produces absorption of the derma, sometimes extending to the bone itself. Not infrequently effusions of serum or blood take place beneath the conical prominence; and, in rare instances, a bursa is found between the corium and the joint.

At a late stage of its growth the corn has the appearance of a central core—technically, *the eye of the corn*—surrounded by a collar of smooth epidermis in the state of callosity. The core is a lamellated ovoid mass, corresponding in external figure with the cup by which it is produced; and consisting in substance of vertical cup-shaped lamellæ closely packed one within the other. In an old corn the shape of the entire core is conical, the point resting on the sensitive skin, and the signification of the term *clou* or nail thus applied by the French is made manifest. The substance of the corn resembles horn both in colour and density, but between the toes, where moisture is generally present, it remains white and soft, like soddened cuticle, and is thence named *soft corn.* Effusion at its base is more common in the soft than in the hard corn.

Treatment.—The treatment of a corn is to remove its causes, namely, pressure and friction; but when this is impracticable, to equalise pressure, by which the corn will revert to the state of callosity. The second indication is best effected by some simple unirritating application, such as the soap- or lead-plaster spread on washleather. As a preliminary to this application, as much of the hard epidermis as possible should be removed by soaking and scraping, and the core turned out with a blunt-pointed instrument. The soft corn may be removed as the hard one, or by snipping with scissors. When there is inflammation about the corn, it should be treated by water-dressing. Chronic corns are much benefited by an application composed of Salicylic Acid, 30 parts; Extract of Indian Hemp, 5 parts; Flexile Collodion, 240 parts.

Erasmus Wilson.

CORNEITIS. — Inflammation of the cornea. *See* Eye and its Appendages, Diseases of.

CORNUAL (*cornu*, a horn).—Relating to the cornua or horns of grey matter of the spinal cord, *e.g. cornual* myelitis. *See* Spinal Cord, Diseases of.

CORONARY ARTERIES, Diseases of.—Synon.: Fr. *Maladies des Artères Coronaires*; Ger. *Krankheiten der Kranzarterien.*—The diseases of the coronary arteries may be classified as follows: (*a*) atheroma and calcification; (*b*) aneurysm; (*c*) occlusion of the orifice; (*d*) thrombosis and embolism; and (*e*) syphilitic disease.

a. **Atheroma; Calcification.** — Atheroma and calcification of the coronary arteries are frequent, but by no means constant, sequelæ of similar changes in the root of the aorta. The disease may be general, affecting both vessels equally or unequally; or it may be limited to one of them, or even to a primary branch of either; and may lead to fatty degeneration or fibroid change of the corresponding substance of the heart. The experiments of Mr. Erichsen and M. Schiff have proved that the nutrition of the heart in health depends upon a free coronary circulation, and pathology has confirmed this conclusion. Sir Richard Quain found the coronary arteries diseased or obstructed in 13 out of 33 cases of fatty degeneration of the heart, and in one of these cases, the trunks of both vessels being healthy, a calcified coronary branch led to the only portion of the heart exhibiting fatty change. Of 55 cases of fatty degeneration of the heart collated from the *Transactions of the Pathological Society of London*, 21 exhibited atheromatous or calcific change of the coronary arteries. In 10 of these death occurred by rupture of the left ventricle, in 1 by rupture of the right ventricle, and in 2 by rupture of the septum ventriculorum, the coronary branch leading to the seat of rupture having been, in every instance, in a more advanced state of disease than the other portions of the vessel. From the foregoing statistics it would appear, that whilst fatty degeneration of the heart may exist independently of disease of the coronary arteries, the latter condition may be regarded as an *immediate* cause of fatty change in the heart, in the proportion of about 38 per cent. of all cases. Hüter points out (Virchow's *Archiv*, vol. lxxxix. 1882) that fibroid disease of the heart is frequently associated with sclerotic changes in the coronary arteries, the fibroid patches corresponding to the site of the changes in the arteries. Fibroid disease may also be produced as a result of embolism of the coronary vessels.

Symptoms and Signs.—There are none which are peculiar to this disease; those which exist being due to the consecutive changes in the substance of the heart. The doctrine formerly held, that calcification of the coronary arteries was the cause of angina pectoris, is no longer tenable, though fatal cases of angina are more frequently associated with disease of these vessels than with any other lesion. It is probable, however, that the affection of the coronary arteries produces angina only by disturbance of the functions of the cardiac nerves and ganglia. *See* Angina Pectoris.

b. **Aneurysm.**—Aneurysm of the coronary arteries is of rare occurrence. It is usually preceded by atheromatous or calcific changes in the coats of the vessels, and may, therefore, be regarded as a disease of middle or advanced age. Dr. Gee has, however, published an example of coronary aneurysm in which the patient was a boy of only seven years.

Symptoms and Signs.—There is no positive indication of coronary aneurysm during life. When the termination is fatal, as it usually is, death occurs by hæmorrhage into the pericardium from rupture of the sac.

c. **Occlusion.**—Occlusion of the orifices of the coronary arteries has been met with only in connexion with calcific changes in the root of the aorta, a partially detached calcareous plate overlying the orifice of either vessel (both are rarely affected), and partially or completely shutting off the circulation. There are no *symptoms* distinct from those of the principal disease.

d. **Thrombosis and Embolism.**—*Thrombosis* of the coronary arteries is a frequent result of disease in the coats of these vessels; and owing to their small size, complete blocking and arrest of circulation through them are the ordinary consequences of this accident. *Embolism* of the coronary arteries has been observed in cases of endocarditis especially involving the mitral valve. The heart-substance, depending upon the occluded vessel for its vascular supply, quickly undergoes the atrophic changes of fatty or fibroid degeneration; or appearances like those found in infarction in other viscera are produced. Special *symptoms* are entirely wanting.

Disease or obstruction of the coronary arteries, with the ordinary consequences—fatty degeneration of the heart, and anæmia with white softening of the brain—are conditions usually found in cases of permanently slow pulse.

e. **Syphilis.**—Syphilitic disease of the coronary arteries has been recorded in a number of instances, but its identification depended entirely upon the history and the concomitant symptoms, the deposit being histologically indistinguishable from ordinary atheroma.

Thomas Hayden. C. J. Nixon.

CORPORA AMYLACEA (*corpus*, a body; and *amylum*, starch).—These minute bodies, which were first described in this country by Sir Richard Quain and Dr. Hughes Bennett in the 2nd and 3rd vols. of the *Transactions of the Pathological Society of London*, were thus named by Virchow. They are generally visible only with the aid of the microscope, but sometimes are large enough to be seen with the naked eye, and now and then attain some size. Usually they are round or oval, and present a concentric, laminated arrangement, which is made more apparent by the action of acetic acid. They often have a yellowish tinge. In appearance corpora amylacea somewhat resemble starch-granules, and they are tinged brown or bluish by the action of iodine upon them. These bodies were formerly supposed to be composed of starch, and hence their name. This is not the case, however, and their actual chemical composition is not clearly known; it probably differs in different structures. Bodies resembling corpora amylacea in appearance and arrangement have been found in various parts, but they have attracted most attention in connexion with the nerve-centres, being particularly observed when these are the seat of atrophy or degeneration; they are especially seen in the choroid plexus.

Frederick T. Roberts.

CORPORA QUADRIGEMINA, Lesions of.—The facts of comparative anatomy and experimental physiology tend to show that the corpora quadrigemina (*corpora bigemina* or *optic lobes* of the lower vertebrates), though related to the optic tracts, do not correspond in their development to the eyes or oculo-motor apparatus, and appear to be largely concerned in those functions, such as equilibration and locomotor co-ordination, which are independent of the cerebral hemispheres.

The facts of human pathology, though not opposed to these data, cannot be made the basis of very precise conclusions as to the diagnostic indications of disease of these ganglia, as it is exceedingly rare to find disease such as local softening limited to this region anatomically or functionally, and hæmorrhage is unknown.

The corpora quadrigemina are, however, not infrequently involved in lesions which invade neighbouring parts, such as meningitis—simple and tubercular, tumours, especially of the pineal gland and the middle lobe of the cerebellum, &c.

It is stated by experimenters on the lower animals (pigeons, &c.) that when the anterior tubercles, which are more especially connected with the optic tracts, are destroyed, vision is abolished, and that if the lesion is unilateral, the blindness occurs on the side opposite the lesion.

It is questionable whether such results occur in man, apart from indirect implication of the optic tracts (neuritis). Dr. Bastian, however, has recorded a case of total blindness, in which the cause proved to be softening limited to the anterior tubercles of the corpora quadrigemina (*Paralysis from Brain Disease*, p. 115).

It has been found experimentally in animals, and also in man, that atrophy of the opposite tubercle ensues when the eye has been destroyed. Irido-motor action is also paralysed by destruction of the corpora quadrigemina, a result which, however, is stated not to occur unless the injury is more than superficial and implicating the oculo-motor nuclei.

Disturbances of equilibration and co-ordination also result from lesion of the corpora quadrigemina. These are attributed to implication of the subjacent tracts, and, according to Lussana and Lemoigne, more particularly to lesion of the subjacent superior cerebellar peduncle. For his own part, the writer thinks that all attempts at differentiation are pure hypotheses, and from the nature of the question must remain so. But, from whatever cause, there is no doubt that the disturbances alluded to do occur.

Irritation of the corpora quadrigemina on one side causes dilatation of the pupil and a hemiopisthotonos of the opposite side, which becomes general if the irritation is prolonged or bilateral, the head being retracted and the legs extended, trismus also being very marked. According to Lussana and Lemoigne unilateral lesion of the corpora quadrigemina causes an incurvation of the trunk and gyration to the side of the lesion. This would agree with the effects of irritation, being naturally a reversal of the phenomena. Tumours implicating the corpora quadrigemina are generally associated with a reeling gait, which is an early symptom, and also frequently with symptoms of ophthalmoplegia from implication of the oculo-motor nuclei. The affection of the ocular muscles is unequal, according to the degree in which the respective nuclei may be affected by the lesion (Nothnagel). In a case reported by Dr. Duffin (*Trans. Clin. Soc. of London*, vol. ix.), which the writer had an opportunity of investigating, of tumour of the pineal gland, which, besides passing forward into the third ventricle, pushed underneath the aqueduct of Sylvius, stretching and causing atrophy of the corpora quadrigemina, the symptoms, in addition to those of cerebral tumour—namely, violent occipital headache and double optic neuritis—were double vision followed by loss of sight, vertigo, specially marked when the eyes were open, staggering gait, and tendency to retraction of the head and rigidity of the dorsal muscles. The pupils were large and sluggish. These symptoms, to a certain extent, resemble those caused by tumour in the middle lobe of the cerebellum, and it is a question how far these latter may be due to mechanical irritation of these ganglia. But we may infer that such a combination of symptoms as the above points to lesion of the corpora quadrigemina, or of the middle lobe of the cerebellum, though we cannot be certain of the absolute limitation of the lesion.

Naturally the same secondary affection of the functions of the cerebral hemispheres occurs from tumours situated in this region as in tumours of the middle cerebellar lobe.

Pressure on the veins of Galen leads to dropsy of the cerebral ventricles, and its consequences on the cerebral circulation and functions. D. FERRIER.

CORPULENCE (*corpus*, a body).—An undue accumulation of fat in the body. *See* OBESITY.

CORPUSCLE (*corpusculum*, a little body).—In physiology and pathology this word is generally used as synonymous with cell. *See* CELL.

CORPUS STRIATUM, Lesions of. The corpus striatum of English anatomy and pathology comprises various structures which have received special names—namely, the *nucleus caudatus*, or intra-ventricular nucleus, which is exposed to view by laying open the lateral ventricle; the *nucleus lenticularis*, or extra-ventricular nucleus, consisting of three divisions, and subjacent to the convolutions of the island of Reil; together with the anterior division of the *internal capsule*, or peduncular expansion, which connects the cortex and crus cerebri.

This differentiation is necessary, as the effects of lesion of the corpus striatum will differ according to whether the grey matter alone, or the internal capsule, is involved.

Physiological experiment has not succeeded in defining the respective functions of the ganglionic masses of the corpus striatum. The experiments of Aronsohn and Sachs, Ott, Hale White, and others seem to show that lesions of these ganglia in animals cause a rise of several degrees in body temperature from increased heat-production.

The corpus striatum is especially liable to lesion from embolism or rupture of its blood-vessels. These are furnished principally by the middle cerebral artery, which in the first part of its course sends off numerous straight twigs, which sink into the anterior perforated space, and supply this ganglion and the adjacent part of the optic thalamus. Owing to their position, and direction as regards the main current, they are easily ruptured or blocked up, and owing to their being of the nature of 'end arteries,' and almost destitute of anastomoses with other cerebral arteries, embolism rapidly leads to softening of the regions which they nourish.

Symptoms.—The symptoms of lesion of the corpus striatum may be divided into three groups or stages.

First stage.—This includes certain symptoms which are more or less transient, and depend chiefly on the suddenness of the lesion and functional disturbance of other parts.

To the latter belong the symptoms usually accompanying an apoplectic seizure (apoplexy), as also the loss or diminution of sensation on the opposite side of the body, which sometimes occurs in consequence of pressure on, or functional interference with, the sensory tracts of the internal capsule by effusion into the corpus striatum. The symptoms due to the suddenness of the lesion of the corpus striatum, as such, are complete paralysis of every voluntary movement on the opposite side of the body, occasionally varied by convulsive spasms of the paralysed side, and conjugate deviation of the head and eyes towards the sound side. This latter symptom is due to the centres for the head and eyes of the opposite hemisphere suddenly losing their antagonists. The temperature of the paralysed side is, as a rule, higher than that of the sound side. The total paralysis and flaccidity of the opposite side of the body, and conjugate deviation of the head and eyes, are transient symptoms, lasting from a few hours to a day or two.

Second stage.—This stage includes those symptoms which continue for a variable period, after those depending on the suddenness and disturbing effect of the lesion have passed off. They constitute the common type of hemiplegia or paralysis of voluntary motion on the side opposite the lesion. The face, arm, and leg, and to a certain extent the thoracic and abdominal muscles on the one side of the body, are affected. The paralysis does not affect all these parts equally. As a general rule it may be stated that those movements are most affected which are most independent of those of the opposite side, and which are most complex and delicate. Hence the movements of the hand and arm are more affected than those of the face or leg, owing to the fact that these are more commonly exercised in associated or alternating action with those of the other side. The facial paralysis is most marked in the lower facial region. The orbicularis palpebrarum is more or less paretic, but never paralysed to the extent which occurs in Bell's or true facial paralysis, depending on lesion of the portio dura. The angle of the mouth on the paralysed side hangs lower, and the tongue deviates slightly to the paralysed side. The weakness of the facial muscles is best brought out when the patient smiles or tries to whistle. The face then becomes drawn to the sound side. While some volitional control may have been acquired over the leg, the hand and arm remain perfectly motionless.

In the process of recovery, the leg recovers before the arm, and as a rule the recovery proceeds from the proximal to the distal end of the limb, the shoulder and hip movements being regained before those of the hand or foot. The flexors regain their power before the extensors.

The sensibility of the paralysed parts is unimpaired. The superficial reflexes are diminished, the deep (tendon) reflexes increased.

The faradic contractility of the muscles is unimpaired; occasionally it is increased rather than diminished.

The muscles do not undergo atrophy except by disuse.

The temperature of the paralysed limbs, which at first is usually increased, is generally found to be lower than that of the sound side, to the extent of a degree, more or less.

Recovery may take place from all the symptoms of this stage, within a period varying from weeks to months, or the patient may pass into the third stage.

Third stage.—The special symptoms of this stage are the occurrence of what is termed 'late rigidity' in the paralysed limbs, a condition of evil import. This rigidity shows itself most frequently in the arm, but it is common enough in both limbs. The rigidity affects the flexors more particularly, and causes the limb to assume a position in which the flexors predominate. It is variable in degree, and at first is capable of being overcome. At first, also, it is remittent, tending to give way when the patient abstains from volitional efforts or from excitement, and seems almost gone on waking from sleep or when the patient yawns or stretches himself. Gradually it assumes a more intense form, and the limb becomes permanently fixed and rigid.

After death, this condition is found to coincide with descending sclerosis of the motor tracts of the brain and spinal cord. The degeneration proceeds from the seat of lesion downwards through the crus, pons, and pyramid of the same side, and then across to the posterior part of the lateral column of the spinal cord on the paralysed side. Frequently, also, a similar track of degeneration is found on the inner aspect of the anterior column of the spinal cord, and occasionally also in the lateral column on the same side as the brain-lesion (Charcot, Türck, &c.)

Even during the rigid stage, there is, as a rule, no trophic degeneration of the muscles or annihilation of faradic contractility, though the muscles waste from disuse unless artificially stimulated. But in some rare instances, as Charcot has shown, the secondary degeneration invades the anterior cornua of the spinal cord, in which case amyotrophy or trophic degeneration of the muscles ensues.

There is no recovery from this condition.

Variations and complications.—Though general hemiplegia of the opposite side, without affection of sensation, is the type of disease of the corpus striatum, certain variations and complications have been observed, some of which still require elucidation.

When sensation is permanently affected along with voluntary motion, we have reason to regard the lesion as not confined to the corpus striatum, but as implicating also the posterior part of the internal capsule and the thalamus, an occurrence by no means rare. When the lesion affects only the grey matter of the nucleus caudatus, the hemiplegia is, as a rule, comparatively slight and transitory.

Similar affection of the nucleus lenticularis is said to produce more marked paralysis than that caused by affection of the nucleus caudatus, but also not of a permanent kind. When, however, the lesion causes rupture of the anterior two-thirds of the internal capsule, the hemiplegia is most marked and most enduring. It is this lesion only which gives rise to secondary degeneration of the motor tracts and permanent rigidity.

Cases are on record in which lesions of the corpus striatum have given rise, not to general hemiplegia of the opposite side, but to monoplegia, such as paralysis of the face or of one or other limb. But these monoplegiæ are without doubt due to limited lesions of the internal capsule, which, as the researches of Franck and Pitres and of Beevor and Horsley have demonstrated, contains the motor tracts corresponding to the differentiated centres of the cortex.

Cases are also on record of paralysis occurring on the same side of the body as the lesion. The real existence and explanation of such exceptional occurrences are still *sub judice*, and though various explanations may be suggested, it is well to wait for further instances, carefully investigated by accurate modern methods, before pronouncing definitely on the question. D. FERRIER.

CORRELATION.—This term is used in medicine almost exclusively in reference to the ætiology of disease, and in this relation principally in regard to the zymotic diseases. The term 'correlation of the physical forces' may be taken as implying that the several forces are capable of being converted into or of giving place to one another when they are permitted to act under certain conditions, and that they are all related to a common cause. It is very much the same idea that is implied by the term 'Correlation of the Zymotic Diseases,' a subject which has been discussed in a separate work by A. Wolff.

It is contended that the several contagious diseases of a general type (the exanthemata) do not, necessarily and in all cases, reproduce their like; but that occasionally, the contagious particles thrown off from the same sick person suffering from one of the diseases (*e.g.* scarlatina) may suffice to engender one or more different kinds of disease, according to the mode in which this matter operates—that is, according as it may be swallowed, taken into the system through the pulmonary surface, or through some other mucous membrane or skin-abrasion. These diseases are said to be correlated, therefore, on account of this assumed relation to a common cause—a specific contagium. According to this notion the seat of primary action and the constitutional condition of the patient are factors which largely influence the form of disease that ultimately manifests itself as a result of the contact of any given contagium. This view has at present scarcely passed beyond the stage of an ingenious speculation—though it is one which is by no means unworthy of further attention, opposed though it may be to many current doctrines as to the specific and unalterable nature of contagia.

Of late years, moreover, evidence in support of some such doctrine has been strengthening. Thus, to take one example, it has now been shown (*see* Dowdeswell's Report in *Brit Med. Journ.*, July 19, 1884) that two very distinct forms of septicæmia exist of an extremely contagious character, which may take their origin from common putrefactive material introduced into different parts of the body. The one, known as 'Davaine's septicæmia,' may be set up by introducing two or three drops of putrid blood beneath the skin of an animal; whilst a totally different form of the disease, known as 'Pasteur's septicæmia,' may be induced by introducing a similar quantity of the same putrid blood into the peritoneal cavity of another individual of the same kind of animal. The late Professor Hueter, indeed, held, as a result of experimental observations, that the contagia of many diseases are derivable from common septic organisms and their alkaloids, by virtue of alterations taking place under particular conditions in the process of putrefaction, by which means the common organisms take on 'specific modes of activity.' Instances of such conversion, as well as of the interchangeable morphological characters of bacilli and micrococci associated with different contagious processes, are cited by him and also by Professor Fokker of Groningen. See *Trans. Intern. Med. Cong.* 1881, vol. i. pp. 329–334.

Diseases may be said to be correlated also when they are severally related to the same cause acting with different degrees of intensity. Thus it is held by some epidemiologists that the plague is only a malignant form of typhus; that yellow fever is due to a more intense form or action of the same poison as suffices at other times to engender intermittent or remittent fever; and that summer diarrhœa, cholerine, and cholera are also but different manifestations of one common though variable cause.

Similarly it is held by many surgeons that ordinary surgical fever, pyæmia, and septicæmia are correlated effects, due to the action of the same poison in different degrees of intensity. They maintain that the appearance of one or other of these morbid states after a surgical operation is dependent in part upon differences in the constitutional condition of their patients, and, moreover, that these forms of disease are further linked to one another by numerous intermediate states. This point of view has been both strengthened and extended by some of the experimental researches of Dr. Burdon Sanderson. He found that the subcutaneous injection of different portions of the same inflammatory product, executed at the same time, would often produce quite different effects upon different animals of the same species. In the one a typical septicæmia proved rapidly fatal, in another a slower pyæmic process was established, whilst in a third animal the still more chronic process of so-called tuberculosis was set up. Here again we seem to get out of the region of speculation into that of fact. See *Trans. Path. Soc. of London*, 1872, pp. 303–308.

The term ‘correlation’ is only applicable to communicable diseases, otherwise its leading signification, namely, convertibility, could not be fulfilled. Hence it is that, though very many diseases may arise from the operation upon different individuals of some common cause (such as exposure to cold), the maladies which may result from such a cause no one would think of speaking of as correlated.

H. Charlton Bastian.

CORROSIVE SUBLIMATE, Poisoning by.—*See* Mercury, Diseases arising from.

CORYZA (κόρυζα, a running from the head).—A synonym for nasal catarrh. *See* Catarrh.

COUGH.—Synon.: *Tussis*; Fr. *Toux*; Ger. *Husten.*

Description.—The *act of coughing* consists in one or more abrupt forcible expirations, preceded by contraction of the glottis. First a deep inspiration is taken, the glottis is closed for a moment, and then it is opened by the pressure of the air forced out by the combined action of the thoracic and abdominal expiratory muscles. With the air thus suddenly expelled, any foreign matter that may be in the larynx or bronchi is driven into the pharynx or the mouth.

Ætiology.—The immediate cause of cough is the presence of an irritant, mechanical or sympathetic, affecting the surface of the air-tubes or the nerves that supply them, and it is the object of the cough to remove this source of irritation.

The sensibility of the respiratory surfaces is greatest at its commencement—the glottis being an ever-watchful janitor. It may be increased by congestion or inflammation, or by the continued act of coughing. Even the mere inhalation of cool or dry air may, in asthma or bronchial congestion, be sufficient to excite cough. The result of the irritation is to increase the natural secretion, and to alter its characters. *See* Expectoration.

Cough may be due to numerous reflex causes, such as gastric irritation, ear-disorder, aneurysmal, glandular or other pressure on the vagus, recurrent, or sympathetic nerves. The act may also be caused by a long uvula or enlarged tonsil; a granular state of the pharyngeal or laryngeal mucous membrane; polypi or other foreign bodies in the larynx, trachea, or even in the external auditory meatus; various affections of the bronchial tubes—for example, undue dryness, hyperæmia, alteration in the quality or quantity of the bronchial secretion, or inflammatory affections; inflammation of the lung or pleura; or tubercle, cancer, or other growths in or near the lung.

Diagnosis.—Cough is not a disease to be treated, but a symptom to be traced to its source. An inspection of the pharynx and larynx, and a physical examination of the chest, will generally suffice to detect the cause.

The character of the cough is often quite pathognomonic—*e.g.* the ‘whoop’ of whooping cough; the ‘bark’ of hysteria; the catching, painful cough of pleurisy; the slight ‘hack’ of early phthisis, and the equally distinctive cough of advanced phthisis with laryngeal ulceration; the tearing cough of empyema threatening bronchial fistula; the loud clanging cough due to pressure on the trachea or laryngeal nerves; the spasmodic, suffocative cough of asthma.

The ‘tightness’ or ‘looseness’ of cough, indicating the absence or presence of secretion, is a valuable guide in diagnosis and treatment.

The *absence of cough* is no proof of the absence of serious lesion; thus, while the presence of a few granulations in the lung is often productive of incessant and uncontrollable cough, long-continued destructive disease may exist without it.

Treatment. — Before prescribing for a

cough it is of course essential to ascertain its cause; and the simplest and most innocuous remedies should be first used. The routine treatment of cough by sedatives is highly injurious. The secretions which ought to be removed are thus locked up, and the irritation, which would have been transient, becomes established.

If the tonsils are found much enlarged, or the uvula pendulous and irritating the epiglottis, caustics or the guillotine will remove the evil. If a granular state of the pharyngeal membrane exists, dependent on torpid or engorged abdominal viscera, gout, or hepatic obstruction, it may be treated by local astringents and general deobstruents.

A lax or congested state of the laryngeal membrane, due to overwork of voice, or the undue direction of attention to the vocal apparatus (clergyman's sore-throat), is best treated, according to the writer's experience, by the local application of a solution of zinc sulphate—ten grains to an ounce of water, or of iodine dissolved in spirit and olive oil. Undue dryness, simple hyperæmia, or hyperæsthesia of the respiratory mucous tract, may often be relieved by the act of sipping and slowly swallowing cold water, or the decoction of Iceland moss, fruit lozenges, gum arabic, liquorice, or linseed tea. Sucking ice or inhaling steam is very often all that is needed. In the early stage of catarrhal sore-throat, chlorate of potassium in crystal, or in the form of lozenge, used in moderation, should not be neglected. The use of glycerine of tannin, or nitrate of silver dissolved in glycerine (half a drachm to one ounce), is of more service in relaxed throat than alum or tannin gargle; indeed, the free use of well-selected lozenges has rendered the employment of gargles well-nigh obsolete. The former can be constantly, the latter but seldom applied.

Medicinal treatment.—If it is desired to increase the fluidity of the secretion, squill or ipecacuanha may be used, or, better still, tartar emetic in small doses, which is best given in effervescence with carbonate of ammonium and citric acid. It must not be forgotten that syrups and nauseating expectorants are apt to do harm by enfeebling or disturbing digestion. Tincture of aconite, in three-drop doses, is often of value in allaying irritable cough, especially when fever is present. Gelsemium is a more recent remedy for the same purpose. Of the direct sedatives, morphine is the most valuable; it proves of service in very small doses, $\frac{1}{12}$ gr. in a lozenge being often adequate. Conium, with or without morphine, suits some persons; hydrocyanic acid still more; and Indian hemp is also of value. The bromides, in combination with chloral, have gained great repute; the latter should be given with caution. The power of the bromide of ammonium in allaying spasmodic cough is remarkable. An emetic of ipecacuanha, sulphate of zinc, or mustard may be useful in relieving cough, by expelling secretion when this has accumulated in large quantity. If cough causes vomiting, food should be taken in small quantities, fluids should be limited, and a little capsicum or spiced brandy 'stays the stomach.'

External applications. — The use of counter-irritants must not be neglected. In the inflammatory stage of bronchitis, for instance, linseed and mustard poultices, and, in the later stages, iodine, are of great use; and in some cases the application of a small blister or vesicating fluid is a remedy not to be forgotten.

Inhalations.—Infusion of hop as an inhalation is a useful calmative; iodine is indicated in relaxed conditions in strumous subjects. Chloroform (10 to 15 minims) mixed with eau de Cologne, and inhaled from a handkerchief, is useful in other cases. By means of the spray-inhaler, many non-volatile preparations may be applied to the respiratory passages. A solution of carbonate of sodium is very useful in liquefying tenacious secretion. Tannic acid, alum, perchloride of iron, and nitrate of silver, are all valuable. Of sedatives, henbane, conium, camphor; and of antiseptics, sulphurous and carbolic acids, are serviceable as inhalants. The vapour of tincture of iodine, 15 drops to 2 ounces of water, in the steam draught inhaler, is often useful. In chronic granular disease of the pharyngeal and laryngeal mucous membranes, the sulphurous waters of Aix-la-Chapelle, Aix-les-Bains, and St. Saveur in the Pyrenees, when inhaled in an atomised state, are of distinct service.

Patients may be *taught how to cough* as follows: Try to suppress the inclination, until the secretion that causes the cough is within reach, then take a deep and deliberate inspiration, and the accumulated phlegm is removed at a single effort. By inhaling steam from a hot sponge or a basin of boiling water on first waking from sleep, the inspissated secretion, which is apt to be difficult to move, may be easily loosened and expelled. An ipecacuanha lozenge may serve a similar purpose. E. Symes Thompson.

COUNTER - INDICATION. — *See* Contra-indication.

COUNTER-IRRITANTS. — Synon.: Fr. *Contre-stimulants*; Ger. *Gegenreizmittel.*

Definition.—The term 'counter-irritation' implies any irritation artificially established with a view to diminish, counteract, or remove certain morbid processes which may be going on in a more or less remote part of the system. The substances employed in establishing this state are called counter-irritants, and may be classified as follows, according to the degree of their action:—1. *Rubefacients.* 2. *Epispastics, vesicants,* or *blistering agents.* 3. *Pustulants.*

Although some therapeutists have of late been disposed to question the value of counter-irritants, on the theoretical ground of inability to explain their mode of action, yet there is not wanting evidence, both from clinical observation and physiological experiment, that irritation in one part of the body may affect the functions and nutrition of other parts. That stimulation of the vessels of the surface can influence decidedly the circulation of deeper parts has been demonstrated by Dr. Brown-Séquard; for he found that irritation of the skin of the back, over the kidneys, caused a contraction of the arteries supplying those organs. Zülzer found that when cantharides collodion was painted over the back of a rabbit for fourteen days the vessels underneath the skin were congested, whilst the deeper parts, including the lungs, were pale and anæmic. From these experiments we can understand how a blister may relieve a sudden internal congestion in the lungs or brain, and how it may act in restoring tone to dilated and paralysed capillaries.

Revulsion and *derivation* are both examples of counter-irritation. In the first, the induced morbid action is set up in a part remote from the primary disease, as when mustard poultices are applied to the feet in an attack of apoplexy; in the second, derivative action is set up in the neighbourhood of the primary malady, as when a blister is placed on the back of the neck for the relief of cerebral disorder.

1. Rubefacients. — Action.— These remedies, applied to the skin, produce local warmth and redness from increased flow of blood in the cutaneous vessels. The local hyperæmia thus induced subsides gradually on ceasing to employ the rubefacient; but sometimes, when the action of this has been prolonged, the epidermis may peel off, and more or less local soreness remain. Rubefacients are usually quick in action; their local after-effects are trifling; and they may, therefore, be applied without injury over a large extent of surface.

Enumeration and Application.—Examples of rubefacients are found in Ammoniacal liniments or embrocations; Mustard plasters and the Compound Liniment; Volatile Oil of Mustard; Oils of Turpentine and Cajuput; and Iodine. Hot water is at times applied on a sponge or flannel to produce a speedy counter-irritant and derivative effect in relieving sudden internal congestion and spasm, as in the early stage of croup, laryngitis, and laryngismus stridulus. The Cataplasma Sinapis, or mustard poultice, is a useful and rapidly acting rubefacient in inflammation, spasm, and neuralgic pain. Sir Alfred Garrod recommends a very useful sinapism, made by mixing 10 minims of volatile oil of mustard with 1 oz. of spirit of camphor, and sprinkling this on impermeable piline. Rigollot's mustard leaves, or the Chartæ Sinapis (B.P.), applied to the skin, produce a speedy rubefaction of the surface. Linimentum Sinapis Compositum is also a very active rubefacient. Vinegar should not be added to mustard poultices; but by mixing some oil of turpentine or a little powdered capsicum in a mustard poultice, its rapidity of action as a stimulant and rubefacient can be greatly increased. Where, on the other hand, a gentle stimulation with warmth and moisture on the surface are desired, as in some cases of pneumonia, a linseed-meal poultice may be used with its surface sprinkled lightly over with mustard meal. Generally twenty minutes is as long as an ordinary mustard poultice can be safely borne on the skin. In persons who have a very delicate skin, a layer or two of muslin should be placed between the mustard application and the surface of the body. In applying mustard poultices to those who are unconscious of pain, caution is necessary, for it has happened that the poultice being left on for a long time has produced dangerous ulceration and sloughing of the surface. A mustard foot-bath is at times employed with a view to a revulsive and counter-irritant effect. To prepare a mustard bath, two tablespoonfuls or more of mustard should be tied in a cloth and agitated well with cold water; then hot water may be added to make the bath. It is found by experiment that cold water extracts the active principle or volatile oil of mustard far better than very hot water does.

Uses.—Rubefacients are used in chronic inflammation and irritation of the mucous surfaces, as in bronchitis, and irritation about the air-passages. Troublesome cough, in cases of phthisis, is often relieved by applying tincture of iodine, or acetic acid and turpentine liniment, to the chest. Rubefacients are of service in removing lingering irritation about a joint, their use also tending to promote the absorption of chronic thickening or effusion in the joint; but friction with a rubefacient liniment over a joint must not be employed till all active inflammatory action has entirely ceased. Various degrees of persistent counter-irritation may be maintained by applying, after the skin has been well cleansed with soap and water, the Emplastrum Picis or Emplastrum Calefaciens of the Pharmacopœia. A mustard plaster applied to the nape of the neck has proved useful in cases of irritable brain with sleeplessness. The same application made to the foot or great toe is a valuable revulsive where gout attacks more important organs. A mustard plaster has the advantage over a blister in rapidity of rubefacient action; and, from the sharp pain caused, the mustard plaster is preferable when it is a matter of moment to rouse one who is in a state of lethargy or torpor from narcotic poisoning by opium, or alcohol, or from coma in the course of a fever. Where we wish to exercise a prolonged action over chronic inflammation in an organ, we should use a blister rather than a sinapism.

2. **Vesicants, Epispastics, or Blistering Agents.**—Action.—A blister acts primarily as a rubefacient and powerful stimulant to the cutaneous vessels. The papillæ of the skin become reddened and raised; minute vesicles soon appear on the elevations; and these, gradually coalescing, form a bleb, or large vesicle, between the true skin and epidermis, containing an albumino-fibrinous fluid.

Enumeration and Application. — The agent most commonly employed for blistering purposes is the Cantharis or Spanish fly; but there are others that have been used for a similar object. Glacial Acetic Acid applied to the skin produces intense redness and pain, with rapid vesication, but its action may extend too deeply as a caustic, and cause a troublesome sore. Liquor Ammoniæ dropped on a piece of lint, applied to the skin, and covered with a watch-glass, very soon causes redness and rapid vesication in most persons. This is a good way of raising a blister when it is desired to apply powdered morphine endermically to relieve severe pain. The Liquor Epispasticus of the Pharmacopœia, applied with a brush, soon raises a blister on the surface. Blistering Collodion is used for a similar purpose, but is slower in action.

The application of blisters should not be made directly over an inflamed part. There is some evidence to show that a strong stimulus applied very near an inflamed organ may increase the paralytic dilatation of its capillaries, and so add to the disease. Blisters should not be applied where the skin is loose, nor over any prominence of bone, nor to the breast during pregnancy. It should moreover be borne in mind that the cantharidine of a blister may be absorbed by the skin, and act on the kidneys, producing strangury and bloody urine. This accident may be obviated by sprinkling powdered camphor over the blister before placing it on the skin, or a thin piece of silver paper may be interposed. In persons of feeble vitality, a blister left on for too long a time has been known to induce dangerous sloughing.

When vesication is specially desired, there is no need to leave the blister on for twelve hours or more, for it may be removed at the end of six or eight hours, and a warm linseed poultice applied. If the blister be opened, which is best done by pricking the most dependent part with a disinfected needle, sweet oil and cotton-wool is the best dressing. The practice of maintaining a blister as a running sore or *exutoire*, by applying irritating ointments, is not often resorted to now. The process causes great pain and exhaustion of the system, and is one rather of depletion than of counter-irritation. In the case of children, blisters should be used with caution, being kept on for about one hour or till the skin is well reddened, when they should be replaced by a poultice. It is well not to open the blister, as the effused serum forms the best dressing covered with cotton-wool. By following this plan the child is saved much worry and pain.

Uses.—In its primary effect a blister acts as a local stimulant, but when it remains on long enough to produce extensive vesication and discharge of serum, it acts as a depletive and depressing agent. This primary and secondary action of blisters has been much insisted on by the late Dr. Graves of Dublin, who found great benefit in cases of fever with apathy and prostration from the application of *flying blisters* to various parts of the surface. Thus a blister over the præcordial region, kept on for about one hour, and then removed, was observed to rouse and stimulate a flagging heart. In other cases the flying blister might be placed at the chest or back, or else behind the head on the neck. Care should be taken not to leave the blister on long enough to cause actual vesication, and the size of the blister should be fairly large.

Vesication by a blister is of service in many brain-affections attended with congestion and tendency to serous effusion, such as in the chronic forms of hydrocephalus, and non-tubercular meningitis. In hysterical paralysis narrow strips of blister placed completely round the affected limb have proved curative. A strip round the throat may cure nervous aphonia. A strip of blister one inch wide may possibly sometimes stay the spread of erysipelas along a surface. In cases of pleuritic or pericarditic effusion the repeated application of blisters to the chest-wall is of manifest advantage. In effusions into joints (hydrarthrosis) blisters aid absorption; and it has seemed to the writer that absorbent remedies, such as iodide of potassium, often begin to do good as soon as a blister appears to have once set the absorptive process in action. In the joint-affections of acute rheumatism, 'the blister treatment' has attracted notice. Armlets and wristlets of blister-plaster are applied close to the inflamed joints during the fever, and the serous discharge from the blister is kept up by means of linseed-meal poultices.

In the obstinate acid vomiting of gouty patients, a blister over the epigastrium often gives relief. Some forms of neuralgia, as for example pleurodynia, may yield to a blister over the seat of the pain. At times obstinate pleurodynia, or mastodynia, can be relieved by flying blisters applied in the vertebral groove on the affected side, where a tender spot can often be detected on pressure. Blisters should be avoided in cases of renal and vesical inflammation, as the absorption of the cantharidine may increase the mischief.

Counter-irritation by heat.—The skin can be rapidly blistered by applying a hammer—'Corrigan's hammer'—a small flat iron heated in a spirit-lamp or boiling water. The skin is tapped for a few seconds with the hammer, just to induce redness of the part. In some forms of rheumatism, neuralgia and spinal weakness, this practice has been followed by satisfactory results. Vesication of the skin by the *ferrum candens*, or hot iron, has been used in chronic joint-disease.

Moxas.—Moxas were used for the purpose of causing severe counter-irritation. European moxas were made either with cotton-wool soaked in solution of nitrate of potassium, or of the pith of the sunflower, which naturally contains this salt. A wet rag was placed on the skin; in the centre of this was a hole in which the lighted moxa was placed, which gradually burned down to the skin and produced an eschar, which in due time separated by suppuration. In spinal affections, and in some forms of paralysis of the sensory and motor nerves, moxas are said to have done good; but their application is very painful, and now they are seldom employed.

3. **Pustulants.**—Action.—The agents belonging to this class of counter-irritants produce a pustular eruption on the part to which they are applied, and their use is not recommended.

Enumeration and Application.—Among pustulants may be placed Croton Oil, Tartarated Antimony, and strong solution of Nitrate of Silver. When croton oil is applied to the skin, it acts as an intense irritant, producing an eruption which is at first papular, but very soon becomes pustular. The oil is best employed in the form of the Linimentum Crotonis of the Pharmacopœia. Tartarated Antimony in the form of the Ointment, or in hot aqueous solution, is a powerful counter-irritant, producing pustules which resemble those of variola. When applied thus it may, by becoming absorbed, induce symptoms of gastro-enteritis. It should not be applied to parts usually uncovered, as the pustules leave marks behind them; and under all circumstances the remedy, being a painful one, must be used with caution. Strong solution of nitrate of silver will produce pustulation, but it is seldom employed for this purpose.

Issues.—Issues have long been used as counter-irritants. An issue is formed by placing on the skin a piece of adhesive plaster, in a hole in the centre of which a fragment of caustic potash is inserted. The caustic causes an eschar, and when this has come away, an issue-pea is placed in the cavity left by the eschar; this pea acts as a foreign body, and keeps up suppuration. One drachm of pus may be discharged daily by an issue; more than this is too great a drain on the system. An issue requires to be dressed daily, and when it has been long open and running it must not be healed too suddenly. Issues over the spine have been found useful in chronic spinal disease; and in some chronic brain-affections, with hyperæmia and congestive tendency, an issue in the back of the neck or in the arm is of service, but is not now much used.

Setons.—A seton is made by passing a narrow-bladed knife under a fold of skin and then carrying a few silk threads through the incision by means of a probe or long needle. The threads remaining in the wound prevent it from healing, and maintain a free purulent discharge. Setons are used for the same purposes as issues, and they have proved useful in certain intractable forms of headache—the seton being inserted in the skin of the neck. Setons have been used in cases of cystic bronchocele with thickened walls; and, as counter-irritants, in chronic inflammation of the bladder and uterus; in chronic skin-diseases of an obstinate character; in inflammations of the eye, with ulceration of the cornea; and in the early stages of pulmonary phthisis.

In acute affections issues and setons are never employed, and they should not be placed over any part where there is much movement, as a troublesome sore may be the result. It is necessary to bear in mind that issues, setons, and pustulants are, like blisters, when kept on long enough to induce serous discharge, of the nature of evacuants. They carry off nutrient material from the blood, and therefore are more or less depressing and exhausting to the system, and their repeated or protracted employment will tend to induce the irritative fever of debility.

John C. Thorowgood.

COUP DE SOLEIL (Fr.).—A synonym for sunstroke. *See* Sunstroke.

COW-POX.—*See* Vaccinia.

COXALGIA (*coxa*, the hip; and ἄλγος, pain).—Pain in the hip-joint. *See* Joints, Diseases of.

CRACKED-METAL or CRACKED-POT SOUND.—Synon.: Fr. *Bruit de pot fêlé.*—A peculiar sound elicited by percussion, and resembling that emitted on striking a broken jar or a metallic vessel. *See* Physical Examination.

CRADOCK, in Cape Colony.—*See* Africa, South.

CRAMP.—Synon.: Fr. *Crampe*; Ger. *Krampf.*—This name is applied to certain painful varieties of tonic spasm. In its most familiar form it affects the calves of the legs, coming on principally at night, on the occasion of some slight movement of these parts. The affected muscles, mostly on one side, contract with such energy as to give rise to a board-like rigidity, together with sensations of an agonising character. The attack rarely lasts more than a minute or two, though it may more or less speedily recur. It is perhaps best cut short by a vigorous but steady voluntary contraction of the opposing extensor muscles of the foot. Where it is more obstinate than usual, firm pressure around the thigh or upon the great sciatic nerve sometimes gives relief. Cramp is often associated with some irritation of the stomach or of the intestines, especially in children or delicate nervous persons. In this way it is produced not infrequently when arsenic in medicinal doses has been continued for some time, and is beginning to exert some slightly poisonous effect upon the system. In a more general form it often occurs, to a marked extent, in cholera. Localised, painful, cramp-like contractions of muscles may also be due to irritation of anterior root-fibres, either in their intra-medullary or extra-medullary course. Other forms of painful spasm are by no means common, if we except colic. *See* SPASM; and THOMSEN'S DISEASE.

H. CHARLTON BASTIAN.

CRANIOTABES (*cranium*, the skull; and *tabes*, thinning).—A morbid condition of the cranium in children, consisting in spots of local thinning of the occipital, parietal, and (rarely) the frontal bones, as well as in general abnormal flexibility of the osseous tissue. *See* SKULL, Diseases of.

CREPITANT (*crepito*, I make a noise). When applied to a body, this word signifies that it is capable of yielding the sensation or sound of crepitation. It is also associated with a râle, to indicate a peculiar character which it possesses. *See* PHYSICAL EXAMINATION.

CREPITATION (*crepito*, I make a noise).—A sensation or sound of crackling. It may be observed in morbid states of the bones, joints, or subcutaneous tissue; but the term is more frequently applied to a physical sign connected with the lungs. *See* PHYSICAL EXAMINATION.

CRETINISM (*crétin*, Swiss *patois* for *chrétien*, a Christian).—SYNON.: Lat. *Cretinismus*; Fr. *Crétinisme*; Ger. *Cretinismus*.

DEFINITION.—A condition of idiocy arising from endemic causes, associated with imperfect development and deformity of the whole body, varying however in degree.

This condition of physical and mental degeneracy is not limited to any nationality. It obtains in tho great mountain-chains of Europe, Asia, and America. In Europe it is met with in the valleys of Switzerland, Savoy, and Piedmont; and it abounds in the neighbourhood of Salzburg, Styria, and the Tyrol. It is less frequently met with in the Pyrenees and in the valleys of the Auvergne in France. Even in England it has been met with in various parts, among others in the dales between Lancashire and Yorkshire. Although more frequently met with in valleys, it is not unknown on plains which are subject to inundations.

ÆTIOLOGY.—The conditions for the development of cretinism are hereditary predisposition; the action of deteriorating influences on the parents, such as unwholesome dwellings and non-nutritious diet; and accidental causes operating on the infant during the period when its physical and intellectual life are developing. The last-named causes are atmospheric and possibly geological conditions, peculiar to special localities. Humidity of the soil and air in valleys where there is little interchange of the atmosphere, and the existence of magnesian limestone in the soil, are probably the most potent factors. Cretinism is not met with as an endemic disease on elevated plateaux, nor in cold countries where sudden changes of temperature are uncommon. Goître is a frequent accompaniment of cretinism, and would appear to be developed under the same conditions. The cases of cretinism met with in England present features which are indicative of a scrofulous origin. There is a condition of idiocy associated with arrest of growth and development at the period of first dentition, not infrequently met with in England, which has been termed *sporadic cretinism*. Some of these cases have been traced to alcoholism on the part of the progenitors, and are usually associated with an absence or atrophy of the thyroid body, and with the development of loose fatty tumours in the supra-clavicular spaces. They remain permanent children, both physically and mentally. They have a strong sense of the ridiculous, and are fond of exciting ridicule in others by their grotesque facial expressions. There is reason to believe that children become cretinoid when taken to reside, at the period of their early development, in localities where the disease is markedly endemic. There are numerous well-attested instances of healthy women living during their pregnancy in cretinic districts bringing forth cretinoid children, who, removing from such localities, propagate healthy children. By far, however, the greater number of cretins arrive at their helpless condition by successive steps of degeneracy in their ancestors. It has been thought that cretinism is due to premature ossification of the cranial sutures, especially of the spheno-basilar suture; and that this is caused by drinking water largely charged with lime. It is impossible, however, to regard this premature ossification, when it does occur, as other than one of the outcomes of the malady, not its cause. Moreover, there are numerous examples where the synostosis is deferred instead of being premature.

Anatomical Characters. — Pathological anatomy shows that the bones of the cranial vault are thickened and without diploë. The basilar groove is generally wanting. The foramina for the passage of arteries and nerves are somewhat smaller than natural. The occipital fossæ are flatter than usual, as if the flattening had resulted from a compression of the cranium from above downwards. Every variety of deformity of the cranium is met with of the brachycephalic type. The brain is usually small, unsymmetrical, pale, and infiltrated with serum. Premature synostosis is occasionally met with at the spheno-basilar suture, and with it a rectangular form of the base of the skull; this, however, cannot be regarded as a constant condition.

Description.—The degrees of cretinism are numerous. A residence in one of the valleys where this affection exists, enables one to trace the various steps of degeneracy, commencing with those who are taking part in the industrial life of the valley, down to the helpless individuals who are leading only a vegetative existence.

The typical cretin presents a very marked physical conformation. He is stunted in growth, rarely reaching five feet in height. His skin is of a tawny yellowish hue, thickened and wrinkled; and looks as if too large for the body. There is also a great increase of subcutaneous areolar tissue. His tongue, large and thick, with hypertrophied papillæ, always displays lessened power of co-ordination; and often hangs from the mouth. The mouth is partly open, margined by thick fissured lips, and with the saliva running over the chin. The face is large; the lower jaw is drooping, and its angle obtuse. The eyes are often affected by strabismus, obliquely placed, and small; and the lids are commonly puffy. The belly is pendulous from the laxness of the skin. The lower limbs are generally short and deformed, and the gait is waddling. The head is deformed, the forehead retreating, the top flat, and the occipital region ill-developed. The cranium is brachycephalic. The nose is broad and flattened. Puberty is often delayed to the twentieth year. The mammæ in the female are large and pendulous; the same remark applies to the genitals in the male. The intellectual faculties are imperfectly developed. The cretin is often unable to speak, and his hearing is frequently defective. The affection is usually associated with more or less enlargement of the thyroid gland. His viability is low, few living beyond thirty years of age. The sexual functions are abnormal; masturbation is frequent; and the subjects of cretinism are often impotent.

Diagnosis.—The diagnosis of cretinism may be made in childhood, from the slowness of the development of the body, the stupid expression, the postponement in the evolution of the teeth, and of the ossification of the fontanelles and sutures, the tawny yellow colour of the skin, the thick and goîtrous neck, the slavering, and the delay of speech and of walking.

Treatment.—This consists in removing the child as early as possible from the circumstances which have produced the disease. He should be taken to a locality where the soil is dry and porous, and should have frequent baths with friction to the surface of the body. The diet should be of the most nutritious kind—a diet into which animal food largely enters. The administration of cod-liver oil and of the lacto-phosphates of lime and iron is indicated. Early education should be commenced as to habits of cleanliness, followed by systematic physical exercise of the various muscles. All intellectual advancement must be sought for through the improvement in every way of his physical condition. The lower animal life may thus be supplemented, if earnest efforts are used, by increased capacity for rational enjoyment, and a more or less useful existence.

J. Langdon-Down.

CRIME, IRRESPONSIBILITY FOR.—Historical Summary.—A medical opinion as to the condition of an accused person is often necessary in order to determine whether he or she can be held accountable for criminal acts. Such an opinion generally depends on the presence or absence of insanity, or on the connexion which may be traced between this mental condition and the act in question. In the article on legal insanity it is explained that it is only within a comparatively recent period that insanity has been admitted as an excuse for crime, except in those comparatively rare cases in which, as Justice Tracey expressed it in 1723, a person does not know what he is doing, 'no more than an infant, a brute, or a wild beast' (*see* Insanity, Legal). This view fairly represents the state of public and of legal opinion until the later years of the eighteenth century. The subsequent enlightenment of the public mind did not receive juristic expression until the trial of Hadfield in 1800, when Erskine first enunciated the doctrine, that 'delusion where there is no frenzy or raving madness is the true character' of such insanity as implies irresponsibility. The most important case in the history of this question was that of Bellingham, who was executed in 1812 for shooting Mr. Spencer Perceval. In this case Lord Chief Justice Mansfield said, that if a person labouring under mental derangement were capable in other respects of distinguishing right from wrong, 'he could not be excused for any act of atrocity which he might commit.' 'It must be proved beyond all doubt,' he added, 'that at the time he committed the atrocious act he did not consider that murder was a crime against the laws of God and nature.' The trial of MacNaughton in 1843 for the murder of Mr. Drummond led to the most authoritative statement of the law which has ever been obtained in this country. MacNaughton was acquitted on Chief Justice Tindal's direction that the point for the jury to consider was whether 'at the time the act was committed' the accused 'had that competent use of his understanding as that he knew that he was doing by the very act itself a wicked and wrong thing.' The general application of this doctrine would have greatly enlarged the area of irresponsibility, and its enunciation at that time produced considerable surprise and even consternation. The matter was indeed regarded as so urgent that the House of Lords immediately ordered a series of questions to be laid before the fifteen judges with the view of settling the state of the law. In the answers to these questions it was in substance laid down that, to entitle an accused party to acquittal on the ground of insanity, it is necessary that he be either of diseased mind, and at the time he committed the act not conscious of right or wrong; or, that he be under some delusion which made him regard the act as right. But this statement has been far from effecting a final settlement of the question.

Most writers on medical jurisprudence have insisted that the real criterion of responsibility is the freedom of the will, or the power of the individual to control his actions. This has been more or less advocated by Esquirol, Marc, Ray, Pagan, Jamieson, Mittermaier, and von Krafft-Ebing. Esquirol dwells strongly on the importance of the freedom of the will. Ray includes it in the comprehensive statement which has received the approval of so many medical jurists. 'Liberty of will and action,' he says, 'is absolutely essential to criminal responsibility, unless the constraint upon either is the natural and well-known result of immoral or illegal conduct. Culpability supposes not only a clear perception of the consequences of criminal acts, but the liberty, unembarrassed by disease of the active powers which nature has given us, of pursuing that course which is the result of the free choice of the intellectual faculties.' Pagan observes that the 'loss of control over our actions, which insanity implies, is that which renders the acts which are committed during its continuance undeserving of punishment.' Jamieson puts the question: 'Had the lunatic at the time of committing the deed a knowledge that it was criminal, and such a control over his actions as ought, if it existed, to have hindered him from committing it?' Dr. Taylor says: 'The power which is most manifestly deficient in the insane is generally the controlling power of the will'; and he expresses the opinion that 'we have here a fair criterion on which responsibility or irresponsibility may be tested.' Dr. Bucknill's view is substantially the same. 'Responsibility,' he says, 'depends upon power, not upon knowledge, still less upon feeling. A man is responsible to do that which he can do, not that which he feels or knows it right to do. If a man is reduced under thraldom to passion by disease of the brain he loses moral freedom and responsibility, although his knowledge of right and wrong may remain intact.' The latest German code puts responsibility upon the same basis. 'An act is not punishable,' according to it, 'when the person at the time of doing it was in a state of unconsciousness; or of disease of the mind, whereby free volition was prevented.' Mittermaier and von Krafft-Ebing sanction the attempt to render the meaning of 'free volition' more definite by describing it as made up of *libertas judicii* and *libertas consilii*—freedom of judgment and freedom of choice. Casper somewhat obscurely defines criminal responsibility as 'the psychological possibility of the efficacy of the penal code.' Mr. Balfour Browne, a recent writer, gives as the best definition 'a knowledge that certain acts are permitted by law, and that certain acts are contrary to law, and, combined with this knowledge, the power to appreciate and be moved by the ordinary motives which influence the actions of mankind.' Dr. Guy thinks that every person who is insane must be regarded as wholly irresponsible, and that the law of England ought to be assimilated to that of France in the declaration that: 'Il n'y a ni crime ni délit lorsque le prévenu était en état de démence au temps de l'action.' Mr. Warren, on the other hand, suggests that a person should not be held irresponsible unless he were as 'unconscious of his act as a baby.' Dr. Maudsley and others hold that the determination of responsibility in cases where insanity is alleged depends on whether a connexion can or cannot be traced between existing disease and the act.

Insanity has been pleaded as an excuse for acts of theft; but such cases are rare, and never occur except where the social position of the accused adds importance to the decision. Indeed it may almost be said that the plea is never raised except in order to avoid capital punishment. Hence it is, that in the discussions which have arisen the question has been intimately associated with the law of murder and homicide. A special inquiry into the state of this law by a Committee of the House of Commons[1] has consequently given occasion to the enunciation of important views as to the legal relations of insanity and responsibility. Evidence was furnished to the Committee by Lord Chief Justice Cockburn, Baron Bramwell, Mr. Justice Blackburn, and Sir James Fitz-James Stephen. The immediate object of the Committee was to examine a bill drawn by Sir James Stephen for the codification of the law of homicide. In the clause of the bill which deals with the relations of disease and responsibility, homicide is stated to be 'not criminal if the person by whom it is committed is at the time when he commits it prevented by any disease affecting his mind—(*a*) from knowing the nature of the act done by him, (*b*) from knowing that it is forbidden by law, (*c*) from knowing that it is morally wrong, or (*d*) from controlling his own conduct.' But it is stated to be 'criminal, although the mind of the person committing it is affected by disease, if such disease does not in fact produce one of the effects aforesaid in reference to the act by which death is caused, or if the inability to control his conduct is not produced exclusively by such disease.' It was, however, proposed in the bill that, 'if a person is proved to have been labouring under any insane delusion at the time when he committed the homicide, it shall be presumed, unless the contrary appears or is proved, that he did not possess the degree of knowledge or self-control hereinbefore specified.' That is to say, where delusion exists, the burden of proving moral capacity would be shifted, the prosecutor having to prove its existence, instead of the accused having to prove its absence. The opinions elicited during the inquiry showed that the law is regarded by legal authorities as being at present too uncertain in its operation, and as failing to recognise some of the most important elements in the question. The divergent character of the recommendations which were made showed, however, that legal opinion is much divided, not only as to the proper relations of insanity and crime, but also as to the essential elements of responsibility. In the meantime, therefore, the statements of the fifteen judges after the MacNaughton case remain the chief exposition of the English law where insanity is pleaded in excuse for crime.

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[1] Report of Select Committee of the House of Commons on the Homicide Law Amendment Bill, July 21, 1874.

Present State of the Question.—It is necessary, in order to justly appreciate the present aspect of the subject, thus to trace its more recent history, and it might be useful to present an estimate of the comparative value of the several tests or criteria which have been proposed for the determination of cases in which insanity has been alleged. These criteria may be broadly summarised in the following six propositions. According to one view a person should be held irresponsible for an act if at the time of committing it (1) he laboured under insanity of any kind or degree; according to another, if (2) he laboured under delusion; or (3) if he was ignorant of right and wrong; or (4) had not power to appreciate and be moved by ordinary motives; or (5) had lost the controlling power of the will; or (6) if the act is traceable to, or its nature has been determined by mental disease affecting the agent. The last of these views is the only one to which fatal objection may not be raised, both on the theoretical and practical sides. The others are all too vague to be of much advantage; and they rather tend to introduce new difficulties than to remove those already existing. The proposition therefore which seems to approach nearest to a solution of the difficulty is that irresponsibility must be admitted whenever the act is traceable to, or its nature is determined by mental disease affecting the agent. It will of course be understood that under such a rule the term 'mental disease' must be held to include both congenital and acquired disorders; arrest of development being as much a morbid condition as functional or structural change. This view of the subject may not be ultimately accepted in the precise terms of the proposition here given; but the principle on which it rests seems to afford the only safe basis upon which we can go. As has already been shown, it has not hitherto been regarded in this light by the majority of the judges; but there have been indications of late years that judicial views are tending in that direction. The late Lord Wensleydale and others have given sanction to the principle in their judicial statements. And the late Lord Justice-General of Scotland (Inglis) gave definite expression to it in one case (*Brown*, Sept. 1866). He told the jury that the main question was 'whether the prisoner was in such a state of insanity at the time, as not to be responsible for the act which he had committed;' and in order to constitute such insanity he said that 'it must be clearly made out that at the time of committing the act the prisoner was labouring under mental disease in the proper sense of the term, and that that mental disease was the cause of the act.' In America the doctrine has been frequently acknowledged, but never more fully and tersely than by Judge Doe, of New Hampshire (*State* v. *Pike*), who comprehensively defined the medical relations of both criminal irresponsibility and civil incapacity, when he stated that a 'product of mental disease is neither a contract, a will, nor a crime.' One important point is to prevent persons from being punished for actions which are the direct outcome of pathological processes. But it is of equal importance to avoid the adoption of a principle which would make the existence of slight mental irregularities incompatible with responsibility. There does not appear to be any danger of this in acting on the principle which is here enunciated. For it lies in the very nature of the cases in which the doctrine could be applied, that the condition to which it is proposed that irresponsibility should be attached must be one which is known to exhibit itself in acts of serious and even criminal character. If the trained observer of disease is able to recognise in an act—which is ordinarily followed by severe punishment—a direct result or a characteristic feature of a morbid process, of the existence of which there may otherwise be sufficient proof, the question of responsibility cannot present any serious difficulty. It may admit of doubt whether a person is responsible for not controlling his actions, or for not knowing right from wrong, or even in some cases for the harbouring of a delusion. But once let it be proved that an act is the natural result of a disease under which a person is known to labour, and the question must be practically removed from the field of discussion. Before, however, the principle can be accepted as fully satisfactory, it is necessary to inquire whether its application would permit insane persons to be held responsible who ought not to be so considered. In other words, are there states of insanity in which a person is irresponsible for acts to which he has not been predisposed or impelled by the insanity? It is perhaps impossible to give such an answer to this question as would be both definite and complete; but for practical purposes we think it may be answered in the negative. Where the insanity is of such a nature that it does not modify the whole conduct, we believe it will be found in practice necessary to admit the existence of responsibility for acts where there is no demonstrable connexion between them and the mental disease. The insane persons who on this principle might be held responsible, would be found solely among those whose irresponsibility could only be admitted after very searching inquiry, and whose insanity was of that kind and degree which has often been declared by medical writers to be consistent with responsibility. It is not to be supposed that under this rule difficulties would cease. It would often be hard to show in cases of actual disease that there was good reason for believing in its existence, or that it was really contributory to the act committed. This, however, would not result from any defect in the principle, but from that imperfection of our knowledge which renders the perfect application of any principle impossible. Let the task of the medical witness be limited to the demonstration of facts indicative of disease and its consequences, and he will at least be acting quite within his special province, and might expect that reasonable weight would be attached to his opinion. And if juries were instructed that the law does not hold a person responsible for acts committed under the influence of disease, it is scarcely conceivable that any one would be found guilty where good cause had been shown even for the reasonable supposition of such an influence. Whatever may be the view ultimately adopted, it would seem to be in every way desirable that the attention of the medical expert should be confined to the elucidation of the medical facts, and that he should not be required to deal with questions which are legal and abstract, and in no way specially medical. The condition known as *diminished responsibility* has not been alluded to in this article. It is only indirectly recognised by British law, and therefore, though much is to be said in favour of its recognition, it is unnecessary to deal with the subject here. JOHN SIBBALD.

CRISIS (*κρίσις*, a decision, a turn).—SYNON.: Fr. *Crise*; Ger. *Krise*.—Crisis is a term applied to the rapid defervescence of an acute febrile disease. It has wandered somewhat from its original meaning, which was 'judgment'—primarily an operation in the mind of the observer, but reflected upon the phenomena observed. The converse term, employed to designate a gradual subsidence of fever, is *lysis*.

Crisis formed at one time the basis of an important medical doctrine. Certain days from the onset of the disease on which the crisis commonly occurred were considered to be propitious. The seventh day was especially favourable, while the sixth was the most unfavourable; speaking generally, the odd numbers or the multiples of 7 were propitious, and the even numbers and such odd numbers as stood near multiples of 7, such as 19, were unpropitious. The preparation also for a crisis was indicated, and the critical day foretold, by remissions perceptible some days previously. The whole morbid process of fever was represented as a process of elaboration by which a *materies morbi* was prepared for expulsion, and an essential feature of the crisis was a critical evacuation, by means of which this was eliminated.

The doctrine of crisis and even of critical dayswas not pure imagination or superstition, but was founded originally on careful observation. In times when nothing was known of the organic lesions which give rise to fever, and in countries where a large proportion of the diseases were of a malarious origin, it would afford data for prognosis and conduce to appropriate treatment; and at the present day in hot climates a crisis is anxiously looked for in febrile attacks on a given day, and, as is well known, a critical fall of temperature and improvement in the general symptoms precede in pneumonia improvement in the physical signs.

In order to constitute a true crisis the defervescence should occupy less than forty-eight hours, and it often takes place in a much shorter time. The fall of temperature should be accompanied by a corresponding reduction in the frequency of the pulse, and should coincide with a feeling of relief and a return of strength; the skin will be warm and soft, the tongue moist, and there will be indications of reviving appetite; there may or may not be a critical evacuation, but the secretions will become more natural in amount and character.

This favourable mode of termination of an acute febrile disease is more common than is usually supposed. The circumstances under which it is most likely to occur are when the attack begins abruptly and the temperature rises rapidly, the natural course of the disease being short and not attended with organic lesions, such as will of themselves keep up fever. After twenty-one days, termination by crisis is not to be expected. The more marked the onset—as, for example, by a definite rigor—the more rapid the rise of temperature, and the greater the height to which it reaches, the greater the probability of an early critical termination.

Occurrence.—The diseases in which the conditions favouring a crisis are realised, and in which this mode of termination is observed, belong to various classes.

Among the *specific fevers*, eruptive and continued, it occurs frequently in variola, but in severe cases it is interfered with by the febrile disturbance excited by the eruption. In measles it is very common. In scarlet-fever a true crisis is seen only in mild cases, though the onset of this disease is peculiarly abrupt. The mode of termination of typhus is essentially critical, but as a rule the crisis is not sharp. Relapsing fever affords the best examples of crisis, which is moreover attended by a critical evacuation in the form of profuse perspiration, the temperature sometimes falling 10° F. in as many hours, and the patient passing from a state of extreme suffering and oppression to almost perfect ease and comfort. In enteric fever *lysis* is the mode of termination.

Remittent fevers often present crises, which may be true and curative, or false and illusive; and the sun fever and common continued fever of hot climates, and tropical diseases generally, have a tendency to fever running high very early and breaking abruptly at a critical period.

In this country *feverish colds*, attacking the throat or taking the form of influenza or catarrh, often terminate critically in three or four days. Erysipelas may so end, but at a later and less definite period. The sharp *febrile attacks* which sometimes occur *after childbirth* often exhibit a very decided crisis. In *pneumonia* the natural termination is by a well-marked crisis, which may take place as early as the fifth day, or be deferred to the ninth, after which a critical termination is not to be expected, and the suspicion may be entertained that the case is not one of frank pneumonia, the prognosis becoming grave. As has been already stated, the general improvement precedes the indication by physical signs of resolution in the inflamed lung. Pleurisy is said also to terminate critically, but it is not in the same definite way as pneumonia.

The *critical evacuations* which entered into the original notion of a crisis are really a common attendant. The most common is a profuse warm perspiration, which may occur whatever the disease may be. Occasionally the evacuation is a copious flow of urine, or it may take the form of diarrhœa. Epistaxis or hæmorrhoidal flux is a more rare and doubtful critical evacuation. A common critical phenomenon is a prolonged, sound, and refreshing sleep.

The question whether or not a favourable crisis affects the odd rather than the even days has been a frequent subject of dispute, and it still remains undecided. It is not, however, of any importance; but another point handed down with the doctrine is worthy of attention, namely, that indications of an approaching crisis are often given two or three days beforehand in slight remissions of fever. By the presence or absence of such remissions at a certain period of the attack, or by a continuous rise of temperature where a remission might be expected, important prognostic information may be afforded and indications for treatment obtained.

Therapeutic Indications. — The main therapeutic deduction from a study of crisis as a termination of acute disease is, that we should not hastily interfere with the reactions by which the system adjusts itself to altered conditions or meets the incidence of the causes of such disease, but contribute to their completion. We do not assume the existence of a *vis medicatrix* tending invariably to the restoration of health; but we must recognise the power inherent in a living organism to respond by internal changes to external influences, and to regain the balance when this has been disturbed. In this process a certain cycle of changes must be gone through, and the great opportunity for treatment of an active kind, should any be required, arises when the course, direction, and probable duration of these changes are known, and when agencies can be brought to bear at a given moment, which will contribute to bring about the appropriate critical evacuation or a critical sleep, through which a return to a normal condition would naturally be effected. William H. Broadbent.

CRITICAL.—Having relation to a crisis. *See* Crisis.

CROUP (Scotch, *croup* or *roup*, hoarseness).—Synon.: *Cynanche trachealis*; Fr. *Croup*; Ger. *Croup*.

Definition.—An acute febrile affection, occurring in childhood, accompanied by inflammatory swelling of the mucous membrane of the larynx, and in some rare cases by the formation of a fibrinous false membrane.

Ætiology and Pathology.—The symptoms of the most usual form of croup, as described below, are due to an acute catarrh of the laryngeal mucous membrane. The condition is, in fact, a simple catarrhal laryngitis, and is not accompanied by the formation of any false membrane. The mucous membrane swells by reason of the congestion of its blood-vessels, and the pouring out of inflammatory exudation into its tissue. Mucus, too, is prone to accumulate on its surface. These conditions are precisely the same as occur in the ordinary catarrhal laryngitis of adults. But in the child the glottis is much narrower than in adults, and the swelling of the mucous membrane from inflammation is greater, and more rapid in reaching its height. Moreover, the larynx is in children more irritable, and therefore its muscles are more easily excited to spasm. Thus when a simple catarrhal laryngitis makes its appearance in a child, it is very shortly followed by laryngeal stenosis, partly from the swelling of the mucous membrane, partly from accumulation of mucus, and partly too from spasm of the laryngeal intrinsic muscles. The condition described is most often due to exposure to cold and damp, especially at a time when the body is heated. It is caused also by scalds of the larynx, when unduly hot fluids are drunk by accident, by wounds, by the irritation of noxious gases, and by the presence of foreign bodies in the larynx. It is more common in male than in female children, and is usually met with between the ages of two and nine years.

But there also exists an inflammation of the larynx which is accompanied by the formation of a false membrane, and it is in respect to this condition that so much discussion has arisen, and even now doubt exists in the minds of some observers. It is, of course, well known that in diphtheria the characteristic membrane may spread from the pharynx, its usual site, into the larynx, and in doing so may produce all the symptoms of so-called croup, in addition to those due to the diphtheria proper. But much of the confusion which existed as to the pathological entity of croup resulted from the non-recognition of those cases of diphtheria in which the local lesion had its primary seat in the larynx. Pathological observations, however, have now placed it beyond doubt, that such cases really exist. Death may occur entirely from the laryngeal stenosis so produced, as in all other and simple obstructions of the larynx. But the diphtheritic nature of the affection is obvious from the other possible terminations of such cases, and from the general symptoms present at the height of the affection. Thus death may also be due to the heart-failure, or to the general blood-poisoning, characteristic of diphtheria. Again, in the acute stages of such a disorder, symptoms may appear, such as great asthenia, excessively frequent pulse, hæmorrhages from various parts, albuminuria, and a formation of diphtheritic membrane on sores far removed from the larynx, which symptoms, while inconsistent with a diagnosis of non-specific membranous inflammation of the larynx, are frequent associations of diphtheria when it occurs in its ordinary form. Moreover, when, in fortunate cases, the acute symptoms have passed away, after an interval the characteristic paralyses of diphtheria may show themselves. The facts of contagion are also of importance, for from such cases of membranous laryngitis, other cases may arise, in which the diphtheritic membrane appears first in the pharynx, and the disease runs its ordinary and unmistakable course. The teachings of bacteriology are perhaps, as yet, not sufficiently definite, in reference to this point, for them to be accepted as absolute proof. It may, however, be noticed that Löffler's diphtheria-bacillus (not merely the micrococci which may be found in any decaying membrane) has been demonstrated equally well in those cases of diphtheria which presumably began in the larynx, as in those where the membrane was limited to the pharynx. Thus it must now be admitted that the local lesions of diphtheria may be limited to the larynx; and, in the opinion of the writer, under this category must be placed by much the larger number of cases formerly styled 'membranous croup.' The description of diphtheria of the larynx will be found in the article Diphtheria.

There remains still a certain proportion of cases of membranous laryngitis which are not due to the action of the diphtheritic poison. Some of these are produced as secondary complications by the poisons of other specific fevers, and amongst these are to be mentioned scarlet-fever, small-pox, measles, enteric fever, and whooping-cough. Yet this question is before us, whether a membranous laryngitis may occur without the action of any specific poison. The older writers assumed that this occurred in a large number of instances, and the prevalence of this view led to the report by a Committee of the Royal Medical and Chirurgical Society in 1879, upon the Relations of Membranous Croup to Diphtheria. That by far the larger number of cases of membranous laryngitis are, in the opinion of the writer, due to diphtheria has already been stated above. But the evidence is also indisputable that the affection may occasionally arise from other and simple sources. Thus, the late Dr. Hilton Fagge[1] recorded, amongst others, cases where both the fauces and air-passages were covered with false membrane, from a

[1] Guy's Hospital Reports, 1877, p. 345.

scald of the throat by boiling water, and again from burns of the fauces; where a foreign body in the bronchus had caused membranous laryngitis; where a similar appearance followed a cut throat, other diseases of the pharynx or larynx not diphtheritic, and pneumonia.

Mr. R. W. Parker,[1] too, has recorded a case where false membranes formed in the larynx after a scald. The Committee mentioned above, reported that cases had fallen under their notice, where 'membranous affection of the larynx and trachea had shortly followed exposure to cold, but their knowledge of the individual cases was not sufficient to exclude the possible intervention or co-existence of other causes.' General pathology would not negative the view that an inflammation, usually simple, might occasionally become membranous. As is mentioned under DIPHTHERIA in respect to the true diphtheritic membrane, an important factor in its production is the occurrence of coagulative necrosis of the epithelial cells, a condition which may arise from the intense action of an irritant usually productive only of catarrhal inflammation. We have a formation of false membrane, analogous to that of the assumed membranous and non-diphtheritic croup in the affection known as plastic bronchitis, in the intestine in dysentery, in the mouth in syphilitic and sometimes in simple stomatitis, and on various mucous surfaces in septic disorders. Further, membranous inflammation has actually been produced experimentally by the injection of acrid irritants into the larynx of animals. *A priori*, therefore, there seems no reason why a membranous laryngitis should not occur without the intervention of a specific poison. Practically, however, it must be concluded, from the evidence at our disposal, that such cases are exceedingly rare, and that false membranes do not form in the laryngitis which forms the basis of what is met with as the simple non-diphtheritic croup of children. It must here be stated, that in modern times the late Dr. Hilton Fagge held an opposite view, though he with great care and fairness considered the arguments against the position he maintained. He believed not only that, in many cases of croup which recovered, false membrane had formed without being detected, but also that a non-specific membranous croup might spread from the larynx to the pharynx and fauces, causing fresh deposits of false membrane on those parts, which most other observers would assume to be characteristic of diphtheria. He suggested that the term 'Croup' should be applied only to cases of membranous and non-diphtheritic laryngitis, while those where no membrane was formed should be known as 'Spurious Croup.'

In former accounts of the pathology of croup, differences are described between the croupal and the diphtheritic false membranes. There are, indeed, differences between the false membranes found on the laryngeal and pharyngeal mucous membranes respectively; but these are due merely to the differences in structure of the mucous membrane attacked. The false membrane is in both cases essentially the same in structure and in its mode of formation. What is said of the diphtheritic membrane will apply to the membrane rarely found in croup, so that no detailed description of the latter need be given here. *See* DIPHTHERIA.

SYMPTOMS.—In accordance with the view expressed above, little will be said under this heading about cases other than those of non-membranous, or as the late Dr. Hilton Fagge styled it, 'spurious' croup. The child affected by this disorder may suffer from general catarrhal symptoms for a time, varying from a few hours to two or three days. More commonly before the actual attack he appears quite well at bed-time, though very often it may afterwards be ascertained that some time during the day he has been exposed to cold or damp, or has sustained a chill. In a few hours, however, he wakes suddenly, as if frightened, breathing hurriedly with loud, hoarse, inspiratory laryngeal stertor. He coughs frequently, making a harsh, metallic noise, but at first removing no mucus from the larynx. He cries, and perhaps speaks, in a shrill, cracked tone, which soon gives place to a mere whistling sound. The character of the breathing, voice, and cough gave rise to the Scotch vernacular name for the disease, 'croup,' which was adopted by Dr. Home in 1765, when describing the affection, and which is now employed by most nations as a scientific term. The child is very restless, tosses his body and limbs about incessantly, clutches at his throat as if to remove the obstruction there, and seizes any surrounding objects with his hands. The face is at first flushed, the eyes bright, and the expression exceedingly alarmed and anxious. Soon, however, the flush becomes dusky, and gradually pallor supervenes, while the whole body is covered with a cold sweat. The feet, and sometimes the hands, not infrequently assume the position found in tetany, and in extreme cases general convulsions may occur. The pulse is frequent and feeble, the temperature is slightly raised. The difficulty with which air enters the chest is obvious from an observation of the patient's position and respiratory movements. The head is thrown backwards, the chin held out prominently, and this position is accentuated at each inspiration by a contraction of the sterno-mastoid muscles. All the extraordinary muscles concerned in chest-expansion are brought into play, and the nostrils dilate at each breath. Yet, in spite of the extra force employed, the thorax is not filled with air. During inspiration the supra-clavicular fossæ, the lower ribs, the epigastrium, and even the lower portion of the sternum are depressed. The yielding of the chest-wall is, as might be expected, more pronounced in rickety children, and in such subjects the whole of the ribs may be seen to give way at the sides as each breath is drawn. If the chest and larynx be auscultated, at first nothing is heard but laryngeal sibilus; afterwards rattling noises are perceived in the larynx, due to the presence of mucus, while in the chest rhonchi may be discovered. The cough, which was at first dry, as the attack continues displaces small pellets of thick, tough mucus; sometimes threads of this substance are expectorated, and have been mistaken for false membrane.

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[1] Clinical Transactions, 1875, p. 144.

Usually, after a time varying from half an hour to two or three hours, the difficulty in respiration subsides, and the child falls asleep again, but not quite free from symptoms indicative of his ailment. His face is somewhat flushed, and there is some degree of pyrexia. The restlessness does not quite disappear even in sleep. The hands and feet frequently retain their tetanoid position. The breathing is still husky and somewhat hurried, and an occasional slight cough has the clanging character noticed during the paroxysm; during the next day, or for the next two or three days, the breathing is hurried and somewhat stertorous, and the attack may return during the next and even succeeding nights. For some time after recovery is apparently complete, any slight cough is prone to assume a 'croupy' character, just as after an attack of whooping-cough the characteristic whoop may at times recur. After one attack, too, or series of attacks, the child may again and again suffer from repetitions of the disorder, even for several years.

As has been stated, this non-diphtheritic membranous laryngitis is not always idiopathic. In such cases the signs of laryngeal stenosis are added to those of the original disease or injury. It is convenient, therefore, to discuss them in the article on DIPHTHERIA, where they will be found in the section upon Diphtheria of the Larynx.

PROGNOSIS.—The prognosis of non-membranous croup is almost invariably favourable in so far as the actual attack is concerned. In spite of the apparent severity of the symptoms, they nearly always subside naturally. The friends of the patient should, however, be warned of the probability that the attack will be repeated at times for some years after its first appearance. Membranous croup, on the other hand, is a much more serious matter. At any moment the false membranes may accumulate or curl up in the larynx, and entirely close the glottis. Nor is the danger merely that of the laryngeal affection. The laryngitis occurs in only severe cases of the specific fevers, and the blood-poisoning of the original disorder, just as in diphtheria, is usually a most fatal condition.

TREATMENT.—As soon as the attack of non-membranous croup has commenced, the child should be placed in a warm bath, to which preferably a little mustard has been added. Sponges, wrung out of water as hot as can be borne, should be applied over the larynx, and renewed as often as they become cold; or a mustard-leaf may be applied here. An emetic, too, is useful. This may be administered in the form of ipecacuanha wine, in doses of one teaspoonful every ten minutes until vomiting comes on. Sir William Jenner recommends that afterwards a dose of calomel and jalap should be given. It is well, too, to place the child in a tent-bed, under the cover of which the nozzle of a steam-kettle is introduced.

Prophylactic treatment is of importance, when the disease has once shown itself. In cold weather the child should be wrapped up warmly, and protected from chills and draughts. At the same time, the larynx may be, as it were, accustomed to cold, by being sponged once or twice a day with cold water. General tonics, too, are of use in warding off future attacks.

The treatment of membranous croup is practically the same as that of laryngeal diphtheria. *See* DIPHTHERIA.

ROBERT MAGUIRE.

CROUP, FALSE.—A term commonly applied to laryngismus stridulus. *See* LARYNX, Diseases of.

CROUPOUS, CROUPY (Scotch, *croup*, hoarseness).—These terms were originally employed with reference to the peculiar crowing or stridulous character of the respiration, cough, and voice in certain affections of the larynx, and signified 'belonging to croup' in its clinical relations; for example, 'croupy cough,' 'croupy symptoms.' When morbid anatomy demonstrated the occurrence of a fibrinous exudation or false membrane upon the affected surface in a special form of croup, the word 'croupous' was used also to designate this false membrane; thus 'croupous exudation' and 'croupous membranes.' The application of the term was afterwards further extended; and it is now employed to indicate the process that leads to a fibrinous exudation in any situation whatever; such as 'croupous inflammation' and 'croupous pneumonia.' Thus the words 'croupous' and 'croupy,' which were originally associated with peculiar sounds, have come in a remarkable manner to express certain physical, chemical, and microscopical characters in the products of inflammation. *See* CROUP; DIPHTHERIA; and INFLAMMATION.

CROWING CONVULSION. — A popular synonym for laryngismus stridulus. *See* LARYNX, Diseases of.

CRURA CEREBRI, Lesions of.—In the crura cerebri lie the paths of communication between the cerebral hemispheres and the periphery. The motor or pyramidal tracts lie in the *foot* or ventral portion of the crus, which is separated from the dorsal portion, or *tegmentum*, by the *locus niger*. The pyramidal tracts of the internal capsule constitute only the middle third of the foot of the crus; the inner third connects the prefrontal lobe with the grey matter of the pons, and, indirectly perhaps, with the opposite cerebellar hemisphere (Flechsig); the outer third, which has been supposed by Meynert to constitute the sensory path, would appear, from the researches of Flechsig and others, to connect the occipito-temporal regions of the hemisphere with the grey matter of the pons, and probably with the cerebellum. The sensory tracts, in all probability, run in the tegmentum or dorsal division of the crus cerebri. The fibres of the third nerve pass through the internal, or mesial, aspect of the crus on their way to the oculo-motor nuclei in the floor of the aqueduct of Sylvius.

From the anatomical and functional relations of the crus cerebri, lesions of this region, such as may arise from hæmorrhage, pressure, &c., are apt to cause paralysis of motion and sensation on the opposite side of the body, as well as oculo-motor paralysis on the same side as the lesion. The degree of implication of the sensory and motor tracts and fibres of the third nerve varies in individual instances; but an *alternate paralysis*, in which there is some degree of oculo-motor paralysis on the one side and paralysis of the limbs on the other, is diagnostic of lesion of the crus. A typical instance of this form of paralysis has been recorded by Weber (*Med.-Chir. Trans.* 1863). In this case there was oculo-motor paralysis on the side of lesion and complete paralysis of voluntary motion, with partial paralysis of sensation on the opposite side of the body. A similar case has been recorded by Rosenthal (*Med. Jahrb.*, 1870). In this case there was, progressively, ptosis on the left side, right hemiplegia, anæsthesia and analgesia. The right third nerve became implicated later. After death a cyst was found in the left crus cerebri, together with a tumour of the size of a bean occupying the interpeduncular space, and compressing the right third nerve. In paralysis from lesion of the crus cerebri, there is, as a rule, also well-marked vaso-motor paralysis, and the temperature of the paralysed side may be two or three degrees above that of the other.

D. Ferrier.

CRUSTA LACTEA (*crusta*, a crust; and *lactea*, milk-like).—Milk-crust: a synonym for *eczema pustulosum* of the face and head, met with in infants at the breast. *See* Eczema.

CRUVEILHIER'S PARALYSIS.—A synonym for progressive muscular atrophy. *See* Progressive Muscular Atrophy.

CUPPING.—Synon.: Fr. *Action de ventouser*; Ger. *Schröpfen.*

This is a mode of treatment sometimes employed to relieve congestion or inflammation of internal parts by drawing blood to the surface of the body. When the blood thus attracted to the superficial parts is actually abstracted from the body by means of incisions, the operation is called *wet*-cupping; and this has been described in the article Blood, Abstraction of. We shall here describe *dry*-cupping, in which no scarifications are made, the blood being simply drawn towards the surface by atmospheric exhaustion, and hyperæmia of the subcutaneous parts or organs thereby relieved.

Formerly cupping was extensively practised, but of late years it has fallen into disuse. In some respects it serves the purpose of counter-irritants, but has a more powerful effect than these; rapid and marked results being sometimes produced upon the circulation of inflamed or congested tissues.

Modes of Application.—Dry cupping is performed as follows: The flame of a spirit-lamp, being allowed to burn for an instant in the dome of a cupping-glass, is quickly withdrawn, and the cup is then rapidly and evenly applied to the skin over the affected part. The heat expands the air contained in the glass cupola, and, owing to the contraction which ensues on cooling, the skin is forcibly sucked up into the cup. It is well first to sponge the skin of the selected spot with hot water, so as to render it more supple and vascular. Slightly moistening the rim of the cupping-glass helps to increase the degree of exhaustion.

An excellent modification of cupping, which has been demonstrated to the writer by Sir Richard Quain, is practised in the following way: Instead of allowing the cup to remain stationary after its application to the skin, as is usual, the operator dexterously slides it to and fro along the surface. When the operation is to be thus performed the amount of surface drawn into the glass must not be considerable. In this way a large tract of skin may be quickly rendered hyperæmic without effusion of blood into its meshes, as happens when the cups are stationary.

Precautions.—Cupping-glasses should be applied where the skin is thick and cushiony, as over the loins, nape of the neck, pectoral region of the chest, &c., and not where bony prominences, or other irregularities, are likely to interfere with complete exhaustion. The edges of the glasses must not be so hot as to burn the skin.

Uses.—Cupping may be advantageously employed in cases of sthenic cerebral congestion, the cups being applied to the nape of the neck; in hyperæmia of the spinal cord; and in inflammation or congestion of the lungs, kidneys, or other viscera. In renal ischæmia it is eminently serviceable. This may be owing to the fact that the blood-supply of the skin of the loins is in intimate relation with that of the kidneys; the vascular supply to those organs being thus directly and immediately influenced. Alfred Wiltshire.

CUTIS, Diseases of.—*See* Skin, Diseases of.

CUTIS ANSERINA (*cutis*, the skin; and *anser*, a goose).—A state of roughness of the skin, resembling that of a goose when plucked, produced by prominence of the pores or follicles. It is due to contraction of the muscular structure of the corium, and is commonly occasioned by cold.

CYANIDES, Poisoning by. — *See* Antidote; and Prussic Acid, Poisoning by.

CYANOSIS (κυανεός, blue).—This, which is really not a disease, is the peculiar blue or more or less livid colour of the surface of the body, especially in certain parts, which is observed in several affections that interfere with the circulation and oxygenation of the blood. The condition is most commonly associated with certain forms of congenital malformation of the heart, and reaches its highest development in them, for which consequently cyanosis is not uncommonly used as a synonym. Lesser degrees of similar discoloration are, however, not infrequently noticed in cases of cardiac disease developed after birth, and they may also accompany pulmonary affections which materially obstruct the circulation. A cyanotic appearance is also one of the obvious effects resulting from all modes of suffocation, and it is observed in the collapse-stage of cholera. The upper half of the body may become extremely cyanotic as the result of obstruction of the superior vena cava. For the pathology of cyanosis, *see* Heart, Malformations of.

CYNANCHE (κύων, a dog; and ἄγχω, I strangle).—Synon.: Fr. *Angine*; Ger. *Bräune*.

This word is used to express an inflammatory condition of the throat, or contiguous parts, in which difficulty of breathing or of swallowing exists, accompanied by a sense or feeling of choking. The term is used synonymously, more frequently on the Continent than in England, with *angina*; an affix, indicative of the seat or nature of the affection, being employed as a designation for each of the several forms or varieties of disease affecting the throat or adjacent parts. Such, for example, are the terms cynanche *laryngea*, or croup; cynanche *maligna*, or malignant sore-throat; cynanche *parotidea*, or mumps; cynanche *pharyngea*, or inflammation of the pharynx; and cynanche *tonsillaris*, or quinsy. *See* these several diseases.

CYRTOMETER (κυρτός, curved; and μέτρον, a measure).—An instrument for measuring the absolute and relative dimensions and movements of the chest-wall. *See* Physical Examination.

CYSTICERCUS.—*See* Entozoa.

CYSTINE or CYSTIC OXIDE (κύστις, the bladder).—A peculiar substance, occurring either in solution or in the form of small crystals in the urine, or as calculi in connexion with the urinary apparatus. *See* Urine, Morbid Conditions of; and Calculi.

CYSTITIS (κύστις, the bladder).—Inflammation of the bladder. *See* Bladder, Diseases of.

CYSTOSCOPE (κύστις, the bladder; and σκοπέω, I inspect).

Definition.—An instrument designed for inspecting the interior surface of the urinary bladder.

Introduction.—Progress in the improvement of the means for inspecting the interior of hollow organs was slow from the beginnings of Bozzini (1807), Segalas (1826), Avery (1846), and Desormeaux (1853 and 1865), and of others by whose apparatus light outside the body was thrown through an inspecting tube on to the surface of the bladder. Among the many workers in endoscopy, Avery and Grünfeld (1874) were conspicuous for their originality and fertility of resource. Avery devised the means of reflecting light in sufficient amount to illuminate the urethra, and his apparatus was modified by Desormeaux and others, but greatly improved by Grünfeld. That surgeon described many conditions of the interior of the bladder in health and disease when seen during life. Dittel and Nitze, in 1876–1879, fixed an electric glow-lamp to the beak of an instrument, and thus carried the source of light into the bladder itself, and so obtained a great intensity of illumination. Nitze, by suitable optical contrivances, brought into view nearly all the surface of the bladder. Previously, when light reflected from without was employed by Grünfeld and others, only a small part of the wall of the bladder—that in immediate contact with the tube—could be seen.

Nitze has arranged the lamp differently in a second instrument, to obtain a view of that small portion of the bladder which the ordinary cystoscope may miss.

Apparatus. — Leiter's forms of Nitze's instrument are the most useful for internal inspection. The apparatus is contained in two tubes, one of which slides in the other. The outer one has the form of an ordinary *coudé* catheter, the angle of junction of the beak with the stem being 130 degrees. The electric current for supplying the lamp passes in through the tube itself, and back by an insulated wire carried in a groove inside the outer tube. The stem just above the angle of the bend is cut away at one side where a right-angled prism is cemented into it. This prism has its hypothenuse silvered, so that rays passing through the exposed face of the prism may be reflected into the inner tube. The inner tube is straight, about eight inches long, and slides in the outer tube. It carries four lenses: one, at the end farthest from the observer, is a hemispherical lens, the flat face of which, on pushing the tube in, goes quite close to that face of the prism which is at right angles to the axis of the instrument. Near to this hemispherical lens is another of very short focal length. The two lenses, receiving rays reflected at the hypothenuse of the prism, form a small image of objects situated opposite the prism, within a field of, say, 45 degrees diameter. This image is very near to the inner surface of the second lens. At the middle of the inner tube is a third lens of focal length somewhat less than one fourth of the length of the tube. This lens takes up the little image from the first and second lenses, and forms of it another image of nearly the same size not far from the end of the tube near the eye of the observer. Lastly, there is a short-focussed lens at the eyepiece for viewing the image formed by the third lens. For convenience we may call this inner tube and four lenses " the telescope."

Besides the telescope and the insulated wire, recent instruments contain two small tubes—one for conveying an inflowing stream of some sterilised or antiseptic fluid to distend the bladder, and keep its contents clear during inspection; the other for allowing the injected fluid to escape after circulating in the bladder, carrying with it any blood or muco-pus not evacuated before the cystoscope was introduced. By a Higginson's air-pump, acting on a reservoir, the stream is maintained constantly, and the bladder-walls are firmly distended—a very important condition for satisfactory inspection. This modification for irrigating during inspection was brought into notice by the present writer.

With the cystoscope above described the observer, on looking down the telescope, obtains a view of that portion of the illuminated surface which is situated within about 25 degrees of a perpendicular to the exposed face of the prism, provided the bladder be fairly distended with fluid. The whole surface of the bladder may be examined, in most cases, by pushing the prism farther into the bladder, or by drawing it back, or by turning the instrument on the axis of the stem, or by tilting the stem. But it is obvious that the parts of the surface near where the instrument enters, and in the region opposite to it, are difficult to bring into view in a satisfactory manner. Nitze has accordingly some different forms of cystoscope adapted specially for those cases, the principal one of which has the window placed in the beak opposite the outer side of the bend, and the light at the farther or posterior end of the beak. By this arrangement the light is thrown directly upon the floor of the bladder, and so passes through the window to the telescope. This form of cystoscope illuminates the area between the uvula and the mouths of the ureters, and often reveals changes there not detected with the ordinary form.

In interpreting the significance of the images obtained, account must be taken of the varying distance and obliquity of different parts of the surface. This will evidently be a matter of difficulty, to be overcome by practice, especially by practice on a model of the bladder, in which the various natural landmarks are represented in bold exaggerated figures.

Application.—In the use of the cystoscope little can be seen if the cavity be not distended or if the contents of the bladder be turbid. When about six or eight ounces of fluid are injected, the surface of the bladder is fairly smooth, reddish or yellow, and racemose blood-vessels collecting into trunks towards the base of the viscus are very distinct. If the walls be tightly expanded the surface may seem glistening white, like mother-of-pearl. On the floor, the trigone is dull red, granular, and somewhat prominent. Near the ends of the ridge at the base of the trigone are placed in two little eminences the openings of the ureters. If the urine coming from a kidney be turbid with pus or other matter, a jet of this turbid fluid can often be seen issuing from the eminence and so discovering the orifice of the ureter. Similarly, if there be ulcers on the mucous membrane, or a papillomatous tumour, a jet of blood can be seen occasionally to dart through the clear fluid, which speedily renders it a luminous red fog, through which nothing definite can be descried. In such cases the apparatus for maintaining a constant flow of ice-cold boracic solution through the bladder is of great service, as the opaque fluid is displaced through the outlet tube, and transparency is restored; and an artificially chilled solution represses hæmorrhage during inspection. If the contents of the bladder be allowed to escape during examination, the view becomes dark, or so indistinct as to prevent recognition of any known object, and then there is danger of the lamp growing hot and injuring the wall of the bladder in contact with it. Hence, whenever the view ceases to be luminous, the electric current should be at once cut off and the bladder refilled. The various changes effected in the appearance of the bladder by disease are described in the article Bladder, Diseases of.

Berkeley Hill.

CYSTS.—Definition.—The word 'cyst' (κύστις, the urinary bladder) is used in pathology without strict scientific accuracy for a closed cavity containing fluid or soft matter; which cavity will have, from the nature of its contents, a spherical or spheroidal shape. The objects thus defined differ much among themselves, and are associated together rather from convenience that on account of any real pathological similarity.

Classification.—Cysts may be classified according to their structure, as simple or compound; according to their contents, as serous, mucous, fatty, &c.; or according to their mode of origin. The latter, though not free from objection, is the basis of description which will be here adopted. Cysts may originate: (1) from *dilatation* of previously existing closed cavities; (2) from *retention* of the products of secretion of a secreting gland; (3) as a part of *new-growth*; (4) by a vice of *development*. These kinds are distinct structures with a wall lined by epithelium. But the name is often given, less accurately, to spaces containing fluid which result from softening of solid tissue, whether in a new-growth or in an inflammatory product. Cystic parasites have also been confounded with cysts properly so called.

1. **Cysts from Dilatation.**— Spaces, normal or newly formed, in connective tissue may, by irritation and consequent excessive exudation, be converted into cysts; or the same result may happen from the confluence of several such spaces. In proportion as the wall becomes smooth, and the shape uniform, they may be called cysts. Bursæ, whether normal or pathological, are cysts. Ganglion in the sheath of tendon is clearly a pathological cyst. To these and like structures the name *hygroma cysticum* has been given. They all contain clear serous fluid, and are lined by an endothelium. Encysted hydrocele may also be called a cyst. One class of ovarian cysts comes under this head, those, namely, which are due to simple dropsy of the Graafian vesicle. Tubo-ovarian dropsy has the same explanation; and cysts of the broad ligament are enlargements of normal structures which are left as relics of the development of the ovary. The thyroid gland seems, from its structure, containing as it does so many closed follicles, particularly disposed to this kind of cyst-formation, and this is doubtless the explanation of bronchocele. The cause of such an enlargement of closed follicles is very obscure, but appears to be immediately due to increased production of the material normally filling the space.

2. **Cysts from Retention.**—Cystic formations may result from the obstruction of the natural outlet of a secreting organ, and the consequent retention of secretion. It is necessary that the walls of the secreting cavity should admit of enlargement, and that the tension should not become so great as to check secretion.

All secreting glands present instances of such cysts. The sebaceous glands of the skin are particularly liable to obstruction of their ducts, and in this way are formed sebaceous cysts, the contents of which are sometimes epithelium and the products of normal secretion, sometimes abnormal products. The same term has, with less propriety, been applied to the sebaceous productions called milium and comedo. *See* Follicles, Diseases of.

The glands or mucous surfaces are liable to similar obstructions, and *mucous cysts* result, such as are sometimes seen in the mouth. Larger cysts in the mouth (*ranula*) result from the obstruction of the ducts of the salivary glands, or are perhaps connected with an abnormal production of gland-substance. The stomach very frequently, other parts of the intestinal canal more rarely, show similar cysts, which, when they project and become complicated in structure, are called polypi. They are occasionally seen on the larynx and trachea. In no part are mucous cysts more frequent than in the uterus, where, indeed, similar formations, the *ovula Nabothi*, must be regarded as normal. The varieties here met with have, as Virchow has pointed out, a close analogy with the various forms of retention-cysts in the skin.

In the mamma, cysts may result from the cutting off of portions of the gland-follicles, but the cysts contained in mammary tumours are not always formed in this way, some being part of new-growths. In the testicle obstruction and cutting off of seminiferous tubes may lead to small cysts, but these are more often connected with new-growths. The curious cysts known as *spermatoceles*, containing spermatozoa, appear to arise from a similar distension of detached portions of testicle-substance, which, by an error of development, have failed to become connected with the excretory ducts. The testicle is also liable to a general cystic degeneration, usually called cysto-sarcoma. Cysts of the kidney are of various kinds, but many, no doubt, both large and small, result from the dilatation of uriniferous tubules and capsules of glomeruli when their outlet is obstructed, as occurs in the cirrhotic form of Bright's disease. The origin of the very numerous microscopic cysts has been much disputed. The writer inclines to the belief that they arise from moniliform contraction of the uriniferous tubes, especially such as contain the hyaline cylinders, known as fibrinous casts. Another form of cystic disease of the kidney is developmental. In this the whole of the organ is converted into a mass of cysts, and is usually much enlarged. This condition may be congenital, and the organ may be so large as to obstruct parturition. It is attributed by Virchow to inflammation of the calyces during intra-uterine life.

To guard against a common error of language, it should be pointed out that the condition of the kidney which results from the obstruction of the ureter, or of the urinary passages lower down, though sometimes called cystic dilatation of the kidney, is not properly a case of cyst-formation, and is better called *hydronephrosis*.

3. **Cysts from New-Growth.** — In many forms of new-growth cysts are produced, but not always in the same way. Occasionally, as in myxoma and enchondroma, softening of portions of new-growth already formed produces spaces containing fluid, which are sometimes, though hardly correctly, called cysts. In many sarcomata, the production of new tissue goes hand in hand with that of cysts, and is sometimes effected, as in glandular organs, by the formation of new follicular structures without an outlet, sometimes by new-growth into the dilated cavities. Polypoid or pedunculated growths on a free surface may sometimes, by the fusion of their extremities, enclose spaces which become converted into cysts. We do not often find cysts forming by themselves a new-growth of so definite a character as to deserve a separate name. When they do so, they may be called cystoma.

4. **Cystoma or Cystic Tumour.**— Cysts are met with in the ovary which come under the definition just given, namely, so-called *compound multilocular cysts*, which constitute the well-known formidable cystic disease of the ovary, and sometimes produce tumours of immense size. In these the originally simple primary cyst appears to become complicated by the formation in its walls of secondary cysts, which may encroach upon or project into the primary. Again there may be papillary growths starting from the inner wall of the primary cyst, which either fill it up, or by fusion enclose spaces, which become secondary cysts. Very complicated structures thus result. The contents may vary in consistence and colour, from clear, pale, albuminous liquid to gelatinous matter, and may be stained through hæmorrhage, or purulent through inflammation. The origin of these structures, which have no precise parallel in other parts of the body, is extremely obscure. It is not even certain whether the primary cysts commence, as might seem *primâ facie* highly probable, in the Graafian follicles ; but they are plainly due to an error of development, possibly beginning in early intra-uterine life, and are not set up by any external causes. The presence of a tubular gland-tissue, such as is found in the rudimentary, but not in the perfect ovary, confirms this view, by throwing cyst-formation back into an early stage in the development of the organ.

In another, but rarer, form of cystic disease of the ovary, equally due to an error of development, and sometimes congenital, the whole organ is found converted into a mass of small cysts, with no striking inequality of size. This variety resembles one form of cystic disease in the testicle and kidney.

Dermoid cysts are those of which the wall is composed of skin or mucous membrane, and generally lined by a layer of flat cells resembling epidermis. The wall may be complicated with connective tissue, forming papillæ resembling those of true skin, and may contain hairs, sebaceous glands—either in connexion with them or unattached—and sudoriparous glands. The accumulation of fatty matter within the cysts is doubtless the result of the continuous activity of the sebaceous glands, the products of which cannot escape. Large masses of hair may also be found, from continuous growth, and there are often numerous detached epidermic scales. Distinctly formed mammary glands, with nipples, are sometimes found. Such a cyst has only the characters of a portion of skin, which might be imagined inverted and included by the growth of the surrounding parts in an early stage of development—an explanation which applies only to those situated in certain parts of the integument where a junction has normally taken place—*e.g.* along the lines of the branchial fissures in the neck, in the anterior middle line of the body, &c.

These simple dermoid cysts are sometimes complicated by containing teeth, it may be in very large numbers (*dentigerous cysts*); but since teeth may also be regarded as cutaneous products, the cyst may still have originated in the skin. This explanation no longer holds, however, when masses of bone are found, sometimes serving for the attachment of teeth, sometimes separate ; as well as other tissues, *e.g.* nervous tissue and striated muscle. Cysts with this variety of contents have been called *proliferative.* Dermoid, dentigerous, and proliferative cysts appear to be always congenital structures, but may show further growth and development in after-life. At least two-thirds of the known cases have occurred in the ovaries. Next to these organs, the testicles are the most frequent seat, but these cysts have been also found in other parts of the body-cavity, in the mediastinum, lung, and even within the skull. The origin of these growths is extremely obscure ; but it is desirable to reject entirely the hypothesis that a mixed tumour of this kind can be the remains of an undeveloped fœtus included in the perfect individual ; a hypothesis rendered improbable by the extreme irregularity of the tissues produced, the teeth, for instance, sometimes numbering one hundred or more. It would rather appear as if, in some instances, a portion of embryonic epithelial tissue had become misplaced at an early period of development. In other cases, these cysts originate in obsolete canals, representing rudimentary structures; such as the central canal of the nervous system, the post-anal gut, the branchial clefts, the vitello-intestinal duct, and others.[1]

Several parasitic animals infesting the human body may appear in an encysted form, and may resemble in appearance true pathological cysts. The commonest—the larval form of *Tænia echinococcus*, or *hydatid cyst*—is known by its laminated wall, and by containing a fluid which is not albuminous, but holds in solution sodium chloride. *Cysticercus cellulosæ* has a transparent wall and clear contents. The other encysted parasites are either very small, as *Trichina spiralis*, or unimportant.

Contents of Cysts.—The serous cysts and hygromata contain an albuminous fluid like that of serous cavities, which may hold enough fibrinogenous material to coagulate spontaneously. Leucocytes may also be present. If inflammation be set up, the proportion of albumin and of leucocytes becomes greatly increased. In the fluid of mucous cysts mucin is contained; in that of colloid cysts, little-known substances which are allied to gelatin. Sebaceous cysts contain neutral fats—sometimes hard, sometimes fluid, and cholesterin. Both mucous and sebaceous products may harden into concretions, and even become calcareous. In renal cysts urea has been found; in biliary cysts, bile-pigment; and in general the products of special secretion may be found in cases of retention, at least in early stages; but if retention last too long, special secretion may cease. Various exceptional contents have been already enumerated.

Treatment.—The treatment of cysts is referred to under the head of Tumours.

J. F. Payne.

D

DACTYLITIS (δάκτυλος, a finger).—A term meaning inflammation of the finger. It is applied to syphilis and struma of the part, as in the terms *dactylitis syphilitica* and *dactylitis strumosa.*

DANDRIFF, or Dandruff (from Celtic *ton*, skin; and *drwg*, foul).—Scurf of the head (*see* Hair, Diseases of). Dandriff is met with in pityriasis, chronic eczema, and psoriasis of the scalp.

DANDY FEVER.—A synonym for Dengue. *See* Dengue.

DARTRE (Fr.)—This term is the French equivalent of the word *tetter*, and is applied to a variety of cutaneous diseases, without strict limitation.

DAVOS-PLATZ, in North Engadine, Switzerland, an Alpine valley at an altitude of 5,177 feet. Well sheltered; atmosphere still and cold. A winter health resort, particularly for cases of phthisis. *See* Climate, Treatment of Disease by; and Phthisis.

DAY-BLINDNESS.—A disorder of vision, characterised by the patient being unable to see in the daylight; called also hemeralopia. *See* Hemeralopia; and Vision, Disorders of.

DEAFNESS.—Loss of the sense of hearing. *See* Ear, Diseases of; and Hearing, Disorders of.

DEATH, Modes of.—The proximate causes of death, whether resulting from natural decay, disease, or violence, may be reduced in ultimate analysis to two, namely, first, cessation of the circulation; and, second, cessation of respiration. On the continuance of these functions, and particularly of the former (if specialisation is possible where all are essential), life of the body as a whole, or of the individual tissues and organs, depends. These functions may cease from causes directly operating on their mechanism, but they may also be brought to a standstill by causes operating indirectly through the nerve-centres which regulate them. Hence it is usual, in accordance with Bichat's classification, to describe this as a third mode of death; so that we speak of death beginning at the *heart*, death beginning at the *lungs*, and death beginning at the *head*. This classification is convenient; for though death beginning at the head is, in reality, death from failure of the respiration or circulation, or of both, through paralysis of the vital nerve-centres, yet the affection of the nervous system is the primary fact, and the phenomena are sufficiently distinct and characteristic to require separate consideration. It must, however, always be borne in mind that, owing to the interdependence of all the vital functions, there is no such sharp line of demarcation, in reality, as we, for convenience sake, make in theory between the various modes of death. The failure of the circulation, however, seems the ultimate factor in the extinction of life, as cases are sometimes met with (of cerebral origin—tumour, &c.) in which respiration ceases and the pulse continues for some comparatively prolonged time, and, indeed, if artificial respiration be resorted to, the heart will continue beating for a long period (an hour or more), the reverse condition not being observed. The suddenness of the death is also in direct ratio with the rapidity of interference with the heart's action. In pure asphyxia it is comparatively slow as compared with that from heart disease or stoppage, and, indeed, ends fatally only by producing that result.

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[1] *Dermoid Tumours.* Bland Sutton, 1889.

I. Death from failure of the Circulation.—This may be (1) sudden, as in *syncope* and *shock*; or (2) gradual, as in *asthenia*.

(1) *Sudden failure of the Circulation.*—As the circulation of the blood depends on the difference in the pressure in the arteries and veins, the circulation will be brought to a standstill by any cause which annihilates, or very greatly lowers, this differential pressure. The cause may be in the heart, or in the vessels, or in both.

(*a*) *In the heart.* As the action of the heart is the chief factor in the maintenance of arterial tension, any organic or structural disease of the heart, rendering it incapable of propelling its contents into the arterial system, will naturally result in cessation of the circulation, and death. Under this general head are to be classed all diseases of the heart and its annexes.

But, apart from structural disease, the heart may suddenly be made to cease through nervous influence. The heart may be inhibited, or be made to cease finally and for ever, either by central causes, such as violent emotion, or a blow on the head, and probably in this way in the sudden death often observed in cases of cerebral abscess and tumour; or by reflex inhibition, as in the case of a violent blow on the epigastrium, or sudden irritation of the sensory nerves of the stomach, as in corrosive poisoning, and even in the ingestion of a large draught of cold water when the system is overheated.

Death from sudden cessation of the heart's action is death from *syncope*. Momentary cessation of the heart's action is transient syncope or fainting. There is sudden loss of consciousness, due mainly to the cessation of pressure in, and anæmia of, the cerebral centres.

(*b*) *In the vessels.* Rapid fall of the blood-pressure, and cessation of the circulation, will naturally be brought about by rupture of the vessels, either from injury or disease, causing death by hæmorrhage; or by occlusion of the pulmonary artery, which seems a commoner cause of sudden death than is usually believed. But, besides actual rupture of the vessels, the vascular area may in certain conditions become so enlarged or dilated, that we may practically have death from hæmorrhage without any loss of blood externally. This is what we observe in death from *shock* or *collapse*. In certain conditions, such as that resulting from blows on the abdomen, the vascular area of the abdomen and viscera may become so dilated as practically to retain almost the entire volume of blood in the body. Hence, even though the heart may be acting, yet the circulation throughout the body generally, and especially in the extremities and superficially, is practically *nil*. The individual may, however, retain his consciousness, and thus he differs from a patient in a state of syncope. But very frequently, in cases of blows on the abdomen, there is not merely reflex dilatation of the abdominal vessels, but also reflex inhibition, for a time at least, of the heart, so that we have syncope and shock co-existing. The symptoms of syncope may pass off, leaving those of shock still remaining. Shock, like syncope, may be either transient or fatal.

(2) *Gradual failure of the Circulation.*—This constitutes death from *asthenia*. This is the natural termination of life, and it is also the mode of death after wasting and exhausting diseases, cold, starvation, &c. The vital powers fade gradually, while consciousness may be retained up to the last moment.

II. Death from failure of the Respiration.—The various ways in which the function of respiration may be interrupted, and the phenomena consequent thereon, have been described under the head of ASPHYXIA, to which article reference may be made.

III. Death from paralysis of the vital nerve-centres—Coma.—As already remarked, death beginning at the head ends by paralysing respiration and circulation. The nerve-centres situated above the medulla and pons are not essential to life, except in so far as animal life is concerned, and the possibility of adaptation to surroundings. Diseases of the brain, however, are liable to prove fatal by indirect action on the medulla and pons through pressure, extension of inflammation, and the like. Certain poisons also, whether introduced from without—such as opium and narcotics generally—or arising within, owing to the non-elimination of waste products, as in uræmia, affect the nerve-centres, both cerebral and spinal, and not only produce unconsciousness or coma, but also paralyse the respiratory and cardiac centres.

In death arising in this manner, the individual lies unconscious, reflex action becomes abolished, and the breathing becomes stertorous and ultimately ceases, death occurring quietly or in convulsions. In death from coma, in addition to the usual phenomena of asphyxia, there is, as a rule, more or less marked congestion of the cerebral and spinal centres.

Management of the Dying.—In whichever of the three ways death may commence, the management of the dying calls for careful attention on the part of the medical attendant; and requires to be specially discussed. *See* EUTHANASIA. D. FERRIER.

DEATH, Signs of.—It is not always easy to determine when the spark of life has become finally extinguished. From the fear of being buried alive, which prevails more abroad than in this country, some infallible criterion of death, capable of being applied by unskilled persons, has been considered a desideratum, and valuable prizes have been offered for such a discovery. The conditions most resembling actual death are syncope, asphyxia, and trance, particularly the last. We cannot, however, say that any infallible criterion applicable by the vulgar has been discovered, and we do not rely exclusively on any one sign, but combine several.

The most reliable sign of death is proof of *cessation of the heart's action.* This, however, is not to be inferred from mere pulselessness, for the heart may still be beating, and resuscitation may be possible, when no pulse is to be felt in the arteries by ordinary manipulation. The use of the stethoscope is necessary, implying, of course, technical skill. Though, according to Rayer, the heart cannot cease to beat for more than seven seconds without death, yet, considering the very slow and feeble action of the heart (8 to 10 beats per minute) in hybernating animals, which normally have a pulse of 80 to 90 per minute, it is well to regard a similar condition as possible in man, and to spend in doubtful cases some minutes, up to half an hour, in auscultation. The so-called cases of life continuing notwithstanding cessation of the circulation, as that of Colonel Townsend, or of the Indian Fakirs, are to be set down as altogether apocryphal, and not scientifically investigated.

To enable unskilled persons to determine whether the circulation continues or not, Magnus recommends the application of a tight ligature on a finger or toe. If the circulation has quite ceased, no change in colour is produced; but if circulation continues, however feebly, the extremity, in course of a longer or shorter period, assumes a livid tint from strangulation of the venous flow, while a ring of arterial anæmia is observable at the point ligatured.

Cessation of the heart's action, if absolutely established, renders other indications unnecessary. As accessories they are useful, but the following signs are none of them individually conclusive, taken alone. The first is *cessation of respiration.* Respiration may not be very obvious, and yet it may be going on. The popular methods, of holding a cold mirror before the mouth and nostrils, and looking for indications of moisture; placing a flock of cotton wool on the lips to ascertain whether air-currents exist; and placing a cup of water on the chest, and observing whether the reflection on its surface moves or remains still, are all well adapted for the purpose in view.

With the cessation of the circulation and vital turgor, the skin becomes ashy pale, there is an absence of the pink colour in transparent parts when examined under the influence of a strong light (Richardson), and the tissues lose their elasticity. The eyeball becomes less tense, and the cornea becomes opaque. The pupils cease to react to light; and there is no vital reaction on the application of irritants to the skin. Though the body is dead as a whole, certain parts may continue to retain their independent vitality after somatic death. This is seen in the muscles, which may retain their electrical contractility from two to three hours after death. The existence of electrical contractility of the muscles in a body supposed to be dead indicates life, or death within the previous two or three hours, according to M. Rosenthal.

The subsequent changes which occur in the dead body not only indicate the fact of death, but aid in fixing the probable period at which death occurred. These are the following:—

(1) *The cooling of the body.*—The body after death, except under certain special circumstances, as in fatal cases of cholera and yellow fever, ceases to be a source of heat-production, and therefore is to be looked upon as an inert mass possessed of a higher temperature than the average medium, which parts with its heat according to certain physical laws. The superficial coldness of collapse, which is due to cessation of the peripheral circulation, must not be mistaken for the cadaveric coldness, for there is still an amount of internal heat which has to be parted with; and the body, cold to the touch before death, may after death rise in temperature, as the internal heat radiates. It is impossible to describe here in detail all the circumstances which modify the rate of cooling of the body; but it may be said in general that all circumstances which favour radiation, convection, and conduction of heat in inorganic bodies are equally applicable here, while the opposite conditions retard. Therefore a thick coating of adipose tissue, clothing, &c., retard cooling. The observations of Goodhart (*Guy's Hosp. Rep.* 1870) and Burman (*Edin. Med. Journ.* 1880) show that under ordinary circumstances we may assume the temperature in the axilla at the time of death to be the normal 98·4 F. Cooling occurs at the rate of 1·6° F. per hour. The rate of cooling is greater (2–4°) during the first few hours. Taking the difference

between the axillary temperature in any given case and the normal, and dividing it by 1·6, would give the number of hours that have elapsed since death.

(2) *Hypostasis.* — After death the blood gravitates to the most dependent parts, both externally and internally, giving rise to livid discolorations, termed *hypostases.* These are liable to be confounded with ecchymoses or extravasations externally, and with the results of congestion and inflammation in the internal viscera. They differ from ecchymoses in the fact that the blood is not extravasated into the tissues, but still contained in the vessels, as may be shown by an incision into the skin. So long as the blood remains fluid, these discolorations may be caused to disappear if the position of the body be reversed; they will again form in the parts which are now the most dependent. They usually occur in from eight to ten hours after death.

(3) *Rigor mortis.*—After death the muscles become stiff, giving rise to *rigor mortis* or cadaveric rigidity. It is due to coagulation of the muscle-plasma. This rigidity attacks the muscles usually in a certain definite order, beginning in the muscles of the neck and face, and gradually extending from above downwards. It gives way to putrefaction and the attendant solution of the coagulated plasma, in the same order; so that, while the upper parts of the body may be flaccid, the legs may be found rigid. It can only be overcome by tearing the tissues, and if overcome it does not return. In this it differs from cataleptic rigidity. A certain amount of mobility is still observable at the joints. In this it is unlike the stiffness of freezing, in which all the parts are equally rigid, and crackle if bent.

The period of the occurrence of rigidity, and the length of its endurance, are extremely variable, so that no definite practical rules can be laid down. It may be said generally, however, that the greater the store of muscular energy at the time of death, the longer it is before rigidity sets in, and the longer it lasts. On the contrary, the greater the exhaustion, the sooner rigidity sets in, and the sooner it disappears. Hence rigidity is longer in appearing in subjects dying suddenly in full muscular vigour, than in those dying from exhaustion. As a rule, a period of relaxation intervenes between death and the occurrence of rigidity, but in certain cases the last muscular contraction seems to pass directly into the rigidity of death. This is seen more particularly in death during great nervous excitement, as in soldiers on the field of battle, or in suicides. The same is said to occur also in death from strychnine-poisoning and in death by lightning, in which the tetanic spasm passes into rigidity.

Rigidity may therefore occur immediately on death or within a few hours. It has never been observed to be delayed beyond a day after death. It may last from so short a time as scarcely to be perceptible, up to a week or more.

(4) *Putrefaction.*—After death the tissues undergo changes in colour, consistence, &c., by which they are ultimately resolved into their simple elements, included under the general term *putrefaction.* Putrefaction, however, may occur locally during life, and general septic changes may occur to some extent before death. The term, however, is not generally applied until the changes are clearly perceptible in alteration of colour, consistence, and smell. The first external sign is a greenish discoloration of the abdomen. Internally the mucous membrane of the larynx and trachea is the first to exhibit change in colour and consistence. The less compact tissues putrefy first, the fibrous tissues resist longer, and—in the female body—the compact tissue of the uterus resists longest of all. In process of time, however, the soft tissues become entirely disintegrated, and the skeleton is exposed and gradually falls to pieces.

The rate of putrefaction is very variable, depending partly on the state of the body itself, but mainly on external conditions as to temperature, moisture, and exposure. A combination of high temperature, moisture, and free exposure supplies the most favourable conditions for rapid putrefaction. A high temperature alone, without moisture, tends to dry the tissues, and thus to produce mummification, instead of colliquative putrefaction. Moisture alone, as when a body lies in water or moist earth, tends to produce a saponification of the tissues, more particularly the fatty, with the formation of a substance termed adipocere (*see* ADIPOCERE). The course of putrefaction can be stopped by antiseptics, as in embalming, and in certain cases of poisoning, as with arsenic, as also by freezing. Putrefaction is more rapid in air than in water, and least rapid in earth. Under ordinary circumstances and average temperatures, signs of putrefaction are clearly visible on the third day after death, commencing with the green hue of the abdomen. Many months elapse before the soft tissues become entirely disintegrated. The uterus has been found fit for judicial examination as long as nine months after death, where no antiseptics had been employed. When such has been the case, however, there is practically no limit to the period of preservation—witness the Egyptian mummies, embalmed thousands of years ago.

There is still much to be learnt respecting putrefaction, and it is unsafe to lay down dogmatic rules as to how far putrefactive changes shall have advanced at a given time, for even under apparently similar conditions the most extraordinary divergences have been recorded. D. FERRIER.

DEBILITY (*debilis*, feeble).—Synon.: Feebleness; Weakness; Asthenia; Fr. *Faiblesse*; Ger. *Schwäche.*

Definition.—The body or any of its organs is said to be in a state of debility when its vital functions are discharged with less than the normal vigour, and when the amount of activity which it displays and of work which it can accomplish is diminished. The term 'debility' is also employed in a somewhat different sense in the case of constitutional weakness of an organ, to convey the notion of vulnerability or predisposition to disease. In this acceptation, 'pulmonary debility,' for example, signifies a peculiarly delicate 'build' of the lungs, which renders them more than ordinarily liable to succumb to the causes of disease.

Ætiology.—Debility is frequently constitutional and inherited; but it is more often developed after birth. It is most commonly due to impaired nutrition, whether this be prolonged and moderate, as in defective hygiene or chronic illness, or, on the other hand, rapid and extreme, as in acute disease. Such failure of nutrition, when local, may arise from the blood being deficient in quality or quantity, or possibly from some interference with the nervous supply. Another frequent cause of debility is the abuse of the affected organ. Over-use of a part leads to fatigue, and if frequently repeated to exhaustion, the chief feature of which is extreme debility, as in cases of sustained and mental exertion, or of repeated strain of the heart. On the contrary, an organ may become feeble from want of exercise. Paralysed muscles furnish the best examples of this condition, but the same may be seen in all organs after unnatural rest. Debility is more liable to occur at certain ages, such as the periods of active growth and development, and in connexion with the menopause; and it is one of the manifestations of advanced life.

Symptoms.—The natural ability of the organs to perform their functions varies extremely with sex, age, previous exercise, and many other circumstances. Debility, or the loss of this functional power, is therefore frequently ill-defined; and, when unquestionably present, may vary greatly in different cases, from a condition in which fatigue comes on only somewhat earlier than usual, as in muscular debility, to a state in which the slightest exertion may exhaust the whole of the vital energy, and the functional life of the part may cease—as is seen in the cardiac asthenia of acute fevers, and scarcely less markedly in certain chronic diseases, such as idiopathic anæmia and Addison's disease.

Debility may be *general*, affecting the whole body; or *local*, individual organs only being involved. Speaking broadly, the symptoms of debility of an organ may be said to be chiefly two. These are, first, increased irritability, or an unnatural readiness of the part to respond to stimulation; and, secondly, a tendency to untimely exhaustion. The phenomena of irritability and exhaustion naturally vary with the organ involved. The symptoms of muscular asthenia are few and simple; those of digestive feebleness are more complex; and in debility of the nervous system the whole of the mental processes, as well as the functions of organic life, may be involved. For a specific account of the phenomena of each of these cases, and of debility of other parts, the reader is referred to the articles upon diseases of the several organs.

Diagnosis.—Debility pure and simple is, as a rule, easily distinguished from *disease* by the absence of all evidence of organic alteration, and especially of physical signs of anatomical change. It is more difficult to separate debility from *disorder* or *derangement*, but careful observation will generally determine in the case of pure debility that the functions are normally discharged as long as the demands made upon them are not excessive.

Prognosis.—Debility due to acute disease may, in the absence of complications, be expected to disappear during convalescence. If the cause have been more chronic, and be less easily removed, recovery will certainly be more slow and less satisfactory. The prognosis of inherited constitutional debility, as regards its disappearance, is nearly always unfavourable.

Treatment.—Debility must be treated according to its cause. If nutrition have failed, it must be restored as far as possible; and until this can be done, stimulants and suitable tonics are indicated—especially in the case of acute disease. Rest is of the first importance in most instances; and frequently it is alone sufficient to restore the vital force. In a few cases, however, the opposite line of treatment must be followed, as in muscular debility from want of exercise or in some forms of paralysis. Where the vital activity is low from constitutional defect, age, or sex, the condition may not be remediable; and the treatment of such cases is chiefly prophylactic. The principal indication then is to secure the subject of debility against exposure to damaging influences.

J. Mitchell Bruce.

DECLINE (*declino*, I decline).—A popular name for any wasting disease; especially associated with pulmonary consumption. The word is also applied to the period in the course of a disease when the symptoms are abating; and likewise to the time of life when the physical and mental powers are failing.

DECUBITUS (*de*, down; and *cumbo*, I lie).—The lying posture. *Decubitus* is also the German name for bed-sore. *See* Posture.

DEFÆCATION, Disorders of.—On the descent of the fæces, which accumulate in the sigmoid flexure of the colon, into the rectum, the associated movements necessary for their expulsion are excited. These movements are chiefly involuntary, though influenced and controlled by the will.

Ætiology.—Some of the more important difficulties interfering with the actions of defæcation arise from disorders in the *nervous system*, by which the movements are excited and directed. In injuries and diseases of the brain or cord, the controlling action of volition, especially its influence over the sphincters, is annihilated, whilst the excito-motor movements depending on the spinal cord continue. In these cases the actions of defæcation take place only when the need of expulsion arises, without any power of the patient to induce or restrain them. In injuries destroying the lower part of the spinal cord, the fæces escape involuntarily in varying quantities and at all times.

Serious troubles in defæcation may also arise from excessive as well as from weakened action of the *muscles* concerned in this function. The sphincter may be irritable or subject to spasm, and resist too forcibly the expulsive actions of defæcation (*see* Anus, Diseases of). Or the muscular fibres of the rectum may lose their tone, and be defective in power and incapable of properly extruding the fæces. Patients thus situated are often obliged, when at stool, to use the finger to dislodge masses retained in the weakened bowel. An atonic condition of the rectum usually arises from over-distension. It may be produced as the result of accumulations, or by too free and frequent use of enemata, the quantity injected being so large as to dilate the bowel and impair the power of its muscular coat. This atonic state of the bowel is itself apt to give rise to fæcal accumulation. The present article will deal with deficient defæcation associated with such accumulation. The opposite condition is described in the next article. *See* Defæcation, Involuntary.

Fæcal Accumulation.—Pathology.—Cases of this kind are not uncommon, yet the nature of the affection is liable to be overlooked. The rectum may become gradually dilated and blocked up by a collection of hard dry fæces, which the patient has not the power to expel, being unable from loss of tone in the distended bowel to overcome the resistance of the sphincter to the passage of so great a body. Some indurated lumps from the sacs of the colon, on reaching the rectum, perhaps coalesce so as to form a large mass; or a quantity accumulated in the sigmoid flexure, on descending into the lower bowel, becomes impacted there. In several instances a foreign body has been found in the centre of the mass. The persons most subject to these troubles are those enfeebled by age or disease, especially women. They may also occur in infants who have been operated on for imperforate anus, when the artificial aperture contracts, or is left too small for the free passage of the fæces. In these cases the distension of the bowel is sometimes excessive, and its expulsive functions are seriously impaired and weakened.

Symptoms.—Such a collection gives rise to considerable distress, producing constipation, a sensation of weight and fulness in the rectum, tenesmus, and forcing pains which women liken to those of labour. In cases of some duration, where the hardened fæces do not quite obstruct the passage, they excite irritation and a mucous discharge, which, mixing with recent fæculent matter passing over the lump, causes the case to be mistaken for diarrhœa.

Treatment.—Injections have no effect in softening the indurated mass: they act only on the surface, and return immediately, there being no room for their lodgment in the bowel. The practitioner on passing his finger finds the rectum blocked up with a large lump, which feels almost as hard as a stone. In such cases the only mode of giving relief is by mechanical interference. The mass requires to be broken up and scooped out—an operation which may require the use of a cocaine suppository, or the administration of an anæsthetic. After the breaking up and extraction of the larger portions, injections of soap and water will be sufficient for the removal of the remainder.

T. B. Curling. Frederick Treves.

DEFÆCATION, Involuntary.—Under normal circumstances the fæces are retained within the rectum by the closure of the sphincter ani. When defæcation takes place, the sphincter is relaxed; and there is increased peristalsis of the lower bowel and pressure on the intestines, from forcible contraction of the expiratory muscles with the glottis closed. The nerve-governance of these three associated phases of the act is different in each case. The contraction of the abdominal muscles is mainly due to an effort of the will. The activity of the colon and rectum is reflex, from irritation of the accumulated fæces. Lastly, the relaxation of the sphincter depends on the inhibition of the tonic centre in the lumbar enlargement of the spinal cord; such inhibition being brought about either in a reflex manner from the rectum or directly from the cerebral centres. It is obvious that the relaxation of the sphincter is the most important stage in the act, for until that takes place no discharge can occur. Up to a certain point the increased peristalsis and pressure on the bowels may be resisted by a voluntarily increased contraction of the sphincter, but at a certain stage the inhibiting influence is exerted, and relaxation results. Since this influence is only in part under the control of the will, it would follow that the chief causes of the involuntary discharge of the fæces are to be found in those conditions which diminish the normal tonicity of the sphincter. At the same time, any circumstances which may increase the pressure of the abdominal muscles, or the activity of the bowels, much beyond what ordinarily occurs, may lead to an involuntary discharge.

Ætiology.—The causes of involuntary discharge of fæces may be discussed in the following order:—

1. *Violent contraction of the expiratory muscles.* This cause of involuntary defæcation is such as may be induced by strychnine-poisoning. It is of rare occurrence in tetanus.

2. *Increased peristaltic action of the intestines.* Increased peristalsis is chiefly dependent on causes of irritation situate in the bowels themselves, such as inflammation or ulceration of the walls; irritating contents; or worms. Extreme fluidity of the fæces is frequently sufficient to induce their partially involuntary discharge, and is noticeable in the looseness sometimes associated with accumulation of fæces in the lower bowel, and the diarrhœa of infants and children.

3. *Abnormal relaxation of the sphincter ani.* As already said, the previously mentioned causes are powerless to produce the discharge of the fæces until the sphincter yields; and how far the sphincter may relax as a result of their efforts, or independent of them, is not easy to determine. The nervous influence emanating from the lumbar centre which normally determines the tonic state of the sphincter may be inhibited by various causes:—

α. Reflexly. Reflex inhibition of the sphincter ani may arise from such causes as worms, fissure of the anus, or calculus vesicæ. It is quite true that the immediate result of irritating the sphincter is to determine in a reflex manner an increase of its contraction, as may be experienced in introducing instruments into the rectum; but it would also seem that at a certain point the irritation may lead to an arrest of the tonic influence, and so allow the sphincter to yield, and this is particularly the case with affections of the bladder.

β. From cerebral disease. That certain emotional conditions may lead to involuntary defæcation is well known, and that a similar result follows some diseases of the cerebral centres is not an uncommon event. The paralysis of the sphincter which occurs under these circumstances is brought about by inhibiting the normal tonic stimulus discharged from the lumbar centres. Involuntary evacuations frequently occur in epileptic fits; in states of profound coma induced by apoplexy, or by opium- and other forms of poisoning; and in death by hanging or suffocation. Its occurrence can scarcely be regarded as indicating lesion of any one part of the cerebral centres, but rather as a result of general brain-states. It constitutes a troublesome complication in such chronic forms of brain-disease as general softening, paralysis of the insane, &c.

γ. From disease of the spinal cord. The relaxation of the sphincter may of course be produced by disease or injury of the lumbar enlargement of the spinal cord. Inasmuch as it is from the cells of this region that the normal tonic influence is understood to issue, destruction of the nervous tissues can readily be understood to prevent the origination of such stimulus to contraction. Certain lesions also above the lumbar enlargement may lead to involuntary passing of fæces by interfering with the cerebral control of the sphincter. It is noticeable that diffused changes in the substance of the cord, such as acute or chronic myelitis, intra-spinal hæmorrhage, and compression, are far more frequently accompanied by paralysis of the sphincter than are the scleroses of a 'systemic' or 'columnar' character—*e.g.* anterior polio-myelitis, lateral sclerosis, progressive muscular atrophy, or inflammatory affections of the spinal meninges.

δ. From local lesion. The control over the sphincter may be lost from injury to the muscle itself. This occurs in laceration of the perinæum, involving the lower end of the bowel; sometimes it is the result of surgical operation, such as deep division of the sphincter in connexion with fistula.

Treatment.—No direct treatment of incontinence of fæces is of avail, beyond removal, when possible, of the cause. This may be done with success when the involuntary discharge depends on the presence of some local irritant, such as worms or fæcal impaction. As a distressing complication of certain diseases of the nerve-centres, which are too frequently incurable, little remains to be done for it beyond adopting such measures as will permit of the escape of the discharge with every regard to cleanliness.

W. H. Allchin.

DEFERVESCENCE (*de*, down; and *fervesco*, I grow hot).—The decline of fever, characterised by a fall of temperature and of pulse, and by other phenomena. *See* Fever.

DEFORMITIES.—*See* Malformations.

DEFORMITIES OF THE CHEST. *See* Chest, Deformities of.

DEGENERATION (*degener*, unlike one's race; out of kind).—Synon.: Fr. *Dégénérescence*; Ger. *Entartung.*

Definition.—The word 'degeneration,' meaning etymologically change or deterioration of kind, is used in pathology for any process by which a tissue or substance becomes replaced by some other, regarded as less highly organised, less complex in composition, of inferior physiological rank, or less suited for the performance of its original functions. While some change for the worse is thus the essence of degeneration, there is great variety in the mode by which this change is effected. It may be by direct chemical *metamorphosis*, as of albuminous into fatty material; by *infiltration* of the tissues with some new material, as in albuminoid degeneration; by *deposition* of some foreign substance, such as lime salts, in the tissues; or even by *substitution* of a newly formed tissue, inferior to the original in organisation or in functional efficiency, as in what is called fibroid degeneration. The degenerative process may be in certain circumstances any one of the above processes. Degeneration is very closely connected with atrophy, since on the one hand it is often caused by imperfect nourishment, and on the other hand may be a stage in progressive wasting; so that it may be difficult to draw the line between the two.

Summary.—The following kinds of degeneration may be recognised: *albuminoid*, *fatty*, *mucoid* or *colloid*, *parenchymatous*, *calcareous*, *pigmentary*, and *fibroid*, with possibly one or two minor varieties of less moment. The two first-mentioned are described elsewhere. *See* Albuminoid Disease; and Fatty Degeneration.

1. Mucoid: Colloid.—This kind of degeneration is in one sense a physiological process, since it is probably by a partial transformation of the protoplasm of epithelial cells into mucin that the secretion of mucus is effected.

Mucoid degeneration and colloid degeneration are sometimes distinguished. We are unable to recognise any difference except in situation, and this distinction is better expressed in other words. The process consists in the transformation of portions (usually albuminous) of the tissues into a semi-transparent homogeneous material, varying in consistency from fluid to a gelatinous solid, and consisting of altered albuminates with variable proportions of mucin, a substance allied to albumin, but differing in its entire insolubility in acetic acid and its solubility in alkalis. All masses of gelatinous appearance have not this composition, since the colloid material which fills some ovarian cysts, that of renal cysts, and probably that found in some other cases, is said to contain no mucin. The thyroid gland when enlarged and cystic, as in one form of bronchocele, is a striking instance of colloid degeneration. The enlarged cystic vesicles become filled with colloid material, which plainly results from a transformation of the epithelial elements, and possibly also of some albuminous exudation in the original vesicles. Small masses of colloid material first appear in the cells, which become confluent into homogeneous masses. In colloid cancer a similar process appears to take place, but it is rather synchronous with, than subsequent to, the growth of the tumour. The alveolar spaces, which in other forms of cancer are filled with cells, here contain colloid material resulting from the metamorphosis of cells; and every transitional stage, from the epithelioid cancer-cell to a homogeneous translucent mass, may often be met with. The stroma is unaffected, and remains fibrous. The gelatinous material of colloid cancer is stated to contain more mucin than that of the enlarged thyroid. It is instructive to notice that this form of cancer usually occurs or commences in parts where epithelium is present, which undergoes the mucous transformation and secretes mucus, as in the stomach and intestines. When colloid or mucoid transformation affects tissues of the connective tissue group, it is the intercellular substance which appears to be chiefly affected. This change is seen in the mucoid softening of cartilage which sometimes occurs in old age, where the chondrin undergoes chemical change, and the intercellular substance softens into a diffluent or liquid substance containing mucin. The so-called mucous tissue, which forms the umbilical cord and the vitreous body of the eye, as well as certain fœtal structures, consists essentially of a reticulated connective tissue with mucous intercellular substance, and the same tissue forms the new-growth called myxoma, which may therefore be regarded as formed by mucous transformation of connective tissue. Its cells are quite unaffected by this change, being either fixed stellate connective-tissue cells, or migratory lymphoid corpuscles. This view explains how portions of other tumours, as sarcoma, enchondroma, and lipoma, are often found to have undergone myxomatous degeneration. All these mucoid or colloid substances contain mucin with albuminates.

2. Parenchymatous.—Synon.: Granular Degeneration; Cloudy Swelling.—This is a peculiar change met with in some epithelial structures, especially liver and kidney cells, and muscular tissue, occurring only in the course of some infective febrile diseases, especially typhus, enteric fever, scarlatina, diphtheria, and pyæmia. The histological elements are found after death to have lost their transparency, and to be filled with minute granules, so that the general appearance is not unlike that of fatty degeneration. The naked-eye appearance of the organs is also not dissimilar: they are pale, dull, and opaque-looking. This change has been thought to be the precursor of fatty change; but, whether this be so or not, it is at once distinguished by the solubility of the granules in acetic acid, and their insolubility in ether. The cause of this degeneration has been asserted to be simply high temperature; still it is not found in all febrile diseases. It has also been regarded as a *post-mortem* change, which is possible, but still this implies some abnormality in the tissues during life.

Another change which occurs in febrile diseases is *waxy* or *vitreous* degeneration of the voluntary muscles. They are found after death with little or no striation, and the myosin irregularly coagulated in lumps. That this is a change occurring after death there can be no doubt; while it is equally clear that this abnormal coagulation shows some abnormality of composition to have existed during life.

3. **Calcareous.**—Calcareous degeneration consists in the deposition of calcareous particles in the elements of a tissue, or in some inflammatory products previously formed. It is more appropriately called *calcareous infiltration* or *deposit.* When the normal tissues are thus infiltrated, there is not of necessity any other alteration in the tissues themselves, though the process generally indicates retardation of the circulation or arrest of tissue-metamorphosis. In the case of inflammatory products, new-growths, and parasites, as well as in other cases, the calcareous deposit follows on partial necrosis or local death. It is, therefore, if not a degeneration, the consequence or accompaniment of degeneration. *See* DEPOSITS.

4. **Pigmentary.**—Pigmentary degeneration is a name which has been given to the changes produced in a tissue or organ by the deposition or formation of pigment. It is very doubtful whether this should always be described as a degeneration, since the change does not necessarily diminish the vital activity of the part, lower its physiological rank, or involve a simpler chemical or anatomical composition. Pigmented tumours do not show less vitality than others, nor is excessive pigmentation of the skin, or any organ where pigment normally occurs, necessarily an accompaniment of degeneration. The colouring matter in this case is the normal pigment called melanin. An entirely different kind of pigmentary change is that which depends upon the extravasation and breaking up of red blood-discs, the hæmoglobin of which becomes converted into a simpler form of pigment, such as hæmatoidin or some other. The pigmentation of the spleen and liver from intermittent fever, and that which is the consequence of chronic venous congestion, are of this kind; and are often the accompaniment of fibroid induration, thus forming part of a degenerative process. Pigmentation in general must not, therefore, be identified with pigmentary degeneration.

5. **Fibroid.**—Fibroid degeneration is the name given to a process frequently met with, in which the original tissue becomes replaced by a form of connective tissue. It is also called *fibroid substitution* or *fibroid change.* In the early stages of this process we find the tissues penetrated with numerous cells of the lymphoid type, which become slowly organised into connective tissue—at first of the cytogenous form, and rarely very vascular. The infiltrated lymphoid cells are probably chiefly derived from the blood-vessels; but some may be, as theory teaches, the descendants of tissue-cells. The process is an essentially chronic interstitial inflammation (*see* INFLAMMATION). Since the final result of the process is that tissue of less physiological value is substituted for the original, the process may be described in general terms as a degeneration, though it is not an actual metamorphosis of tissue. It finally leads to induration, contraction, and partial atrophy. J. F. PAYNE.

DEGLUTITION, Disorders of.—SYNON.: Disturbances of Swallowing; Fr. *Troubles de la Déglutition*; Ger. *Störungen des Schluckens.*

Before describing the disorders of deglutition or swallowing, it is necessary to state briefly in what this physiological act consists, and how the process is performed.

PHYSIOLOGY OF DEGLUTITION.—The act of deglutition is commonly divided into three stages. The first is a voluntary effort, accomplished by means of the tongue and the muscles of the cheeks and mouth, as far back as the anterior arch of the fauces. The second stage is an involuntary act, though certain voluntary muscles are engaged in effecting it. It is accomplished by the action of those muscles the duty of which is to retract the tongue, to raise the larynx and close the glottis, to lift the soft palate, to contract the fauces and bring the tonsils in contact with the bolus of food, to close the posterior nares, and to raise and contract the pharynx. Then the food passes into the œsophagus or gullet, when the third stage is entered upon; and as the morsel passes into this tube, a progressive undulatory or peristaltic movement of the gullet is produced, by which the bolus is propelled into the stomach.

DEFINITION.—Any condition which interferes with the perfect integrity of this physiological process constitutes a disorder of deglutition. The general term which is applied to this condition is Dysphagia or *deglutitio impedita,* as it is sometimes termed. But, in actual fact, such conditions will be found to be dependent for the most part on some other morbid state of the structures immediately concerned in the act of swallowing, or of those in close proximity to them. Yet, although dysphagia must, as a rule, be regarded merely as a symptom of some more or less serious disorder, still it may be convenient and useful to examine the subject somewhat more in detail than can be done in the consideration of those affections in which it frequently plays so prominent a part.

Ætiology.—All affections of the throat modify in some way the power of swallowing, and render the act of deglutition painful and difficult. Thus:—1. We meet with it as one of the symptoms in acute catarrh of the pharynx, in tonsillitis, and in ulceration of the throat. 2. Similarly, diseases of the larynx may give rise to disorders of deglutition; such as laryngitis, inflammation of the perichondrium, and laryngeal polypi. 3. Specific diseases—for example, phthisis, syphilis, cancer, scarlatina, measles, and croup—are another fertile cause of difficulty of swallowing, owing to their affecting the throat in various ways. 4. So also are nervous affections — for instance, post-diphtheritic paralysis, hysterical disorders, general paralysis of the insane, progressive muscular atrophy, and glosso-pharyngeal paralysis. 5. Affections of the salivary glands, such as parotitis, may interfere with deglutition. 6. Œsophageal disorders, whether functional, or causing organic obstruction, are important causes of dysphagia. 7. Difficulty of deglutition may result from pressure upon some part of the passage, as by an aneurysm of the thoracic aorta, a solid tumour, whether malignant or benign, or a retro-pharyngeal abscess. 8. It may be set up by the character of substances swallowed—*e.g.* when these are irritant, corrosive, or very hot articles. All these causes, though in different degree, offer some impediment to the act of deglutition.

Symptoms.—Although difficulty in the act of swallowing is the essential symptom in many and various affections, yet this differs greatly in degree, as well as in the attendant phenomena, according to the pathological condition of the parts involved. Thus, when irritation of any kind is met with in any part of the track through which the bolus of food has to pass, then the act of deglutition is attended merely with more or less pain, which in such cases constitutes the sole difficulty in the process. When, however, the calibre of this portion of the alimentary canal is reduced by disease affecting its own structure, or when it is encroached upon by morbid growths or other disease in its immediate vicinity, a mechanical impediment is set up, which necessitates a certain amount of voluntary effort to accomplish the act. This supplementary aid is usually sufficient to propel the bolus onwards; and deglutition, though slower than in health, and usually attended with pain, may be successfully performed. It occasionally happens, however, that the obstruction is so great as to prevent the passage of at least the larger portion of the food downwards, and regurgitation takes place through the mouth or nostrils.

A similar result is brought about when paralysis affects any portion of the muscular structures concerned in the act of swallowing, but obviously in a different manner. For example, in post-diphtheritic paralysis, in consequence of the implication of the soft palate and neighbouring structures in this loss of power, the food, instead of passing into the gullet, returns through the posterior nares.

The dysphagia occasionally observed in hysterical persons, and which appears to partake of the nature of spasm, differs essentially from those forms already described, in the fact that it is not a constant phenomenon, and that it is but one manifestation of the neurotic temperament.

Treatment.—This will manifestly depend upon the recognition of the cause which gives rise to the impediment in swallowing. Cases of simple catarrh of the mucous membrane of the throat, and those produced by the action of irritant substances generally, yield, after a short interval, to the use of bland articles of diet and demulcents, such as olive oil, milk, linseed tea, &c. It must, however, be borne in mind that permanent stricture of the œsophagus may be the result of causes such as those last mentioned. Of course, when abscess is the cause of the dysphagia, the evacuation of its contents will give immediate relief. In that form of dysphagia dependent upon diminution of the calibre of the œsophagus, the question of its treatment by the use of bougies or stomach-tubes should be considered. *See* Œsophagus, Diseases of.

The dysphagia dependent upon specific disorders of the larynx, such as that occasioned by phthisis, syphilis, or cancer, may often be greatly mitigated by the use of warm medicated sprays containing sedative drugs, such as bromide of ammonium, opium, or chlorine water; a 15 or 20 per cent. solution of menthol in liquid vaseline or olive oil, injected into the larynx and pharynx; also a 4 per cent. solution of cocaine, &c. In cases acknowledging a nervous origin, the treatment must bear reference to the general nervous disorder of which the dysphagia is but a symptom. Thus, hysterical dysphagia may be speedily removed by the application of galvanism in the neighbourhood of the œsophagus. Post-diphtheritic dysphagia usually disappears as the health of the patient improves, and is to be treated by the administration of nervine tonics, such as strychnine, iron, and quinine.

The food should be of semi-solid consistence, concentrated, and small in bulk—*e.g.* iced milk, cream-ice, jellies, switched egg, or the unbroken raw egg, custard, and oysters.

C. Muirhead.

DELHI SORE OR BOIL.—Synon.: Aleppo Evil; Mycosis Cutis Chronica (V. Carter); Lupus Endemicus (Lewis and Cunningham); Oriental Sore (Fox). Fr. *Bouton d'Alep*; Ger. *Beule von Alep*.

Definition.—An indurated, indolent, and very intractable sore; papular in the early, encrusted or fungating in the advanced stages; spreading by ulceration of skin; single or multiple; and often occupying extensive surfaces of the exposed parts of the body, such as the face, neck, and extremities. It is capable, if inoculated, of reproducing the disease; and it also affects dogs and horses.

GEOGRAPHICAL DISTRIBUTION.—This disease occurs in India, especially the North-west Provinces, Punjab, Cabul and Scinde, Persia, Arabia, Crete, the Sahara of Africa, perhaps China, and doubtless wherever certain peculiar conditions of soil and hot climate coexist; for example, an epidemic lately (1889) prevailed in Greece. Though called Delhi boil, it is neither a furunculus, nor is it peculiar to that city. The Scinde boil, the sores of Roorkie, Moultan, Lahore, Meerut, other crowded Indian cities, and Aden, are probably only varieties, if not identical. The same may be said of the Bouton d'Alep of Biskra, Bussorah, Baghdad, and Crete. Slight differences may exist, but essentially they are the same disease. The Yeman and Cochin China sores are probably varieties, as are other indolent indurated and intractablo sores occurring in persons of impaired health, residing in hot and malarious climates, who use certain waters, and in whom there is neither syphilitic nor strumous taint.

ÆTIOLOGY AND PATHOLOGY.—Drs. Fleming and Smith, V. Carter, and Lewis and Cunningham give the best account of the disease. Though called a local disease, it is probable that the state of the health has much to do with its production, certain conditions of climate, soil, and especially of drinking-water being also concerned. Furunculi of a severe and painful though different character are prevalent in hot climates at certain seasons of the year, in enervating and malarious climates like India, especially after the rains, *i.e.* towards the termination of the most exhausting season, when the vital powers have been depressed during the preceding months, and the functions of the liver and spleen are impaired. The blood, imperfectly elaborated, and not freed from excrementitious matter, is then in a condition in which it not only ministers imperfectly to nutrition, but is prone to fibrinous coagulations, which cause capillary embolism, giving rise to local starvation and death of minute portions of areolar tissue in or under the integument. These result in suppuration, which is set up for the purpose of getting rid of the dead fragment or core. An analogous, though perhaps not precisely similar, pathological condition may be concerned in the causation of the Delhi sore, and is not incompatible with an otherwise fairly good condition of the general health. Water, soil, food, bites or stings of insects, parasitic micro-organisms, insanitary conditions, such as exist in crowded native cities, have all been charged with causing the disease. Improved hygiene, planting of trees, and change of water, food, and locality, have all been credited with benefit in the treatment of it. The facts that this peculiar form of sore manifests itself under similar climatic conditions in other parts of the world, which, it is to be noted, are generally those of the more arid regions, and that it occurs most frequently at the most exhausting season, seem to point to a constitutional state as a predisposing cause.

The disease is not confined to human beings. In Delhi it has been observed that dogs are very liable to be affected, especially in the nose, and this, from the position of the sore, has been adduced as strong evidence in favour of the theory that it is due to the presence of a parasitic organism which finds its way there from the water. In some districts other animals are affected; and it seems probable that the indolent, indurated, and intractable sore that horses are liable to in India, called *Bursattie* (Rain Sore), is of the same character. Further investigation into the causation and pathology of Delhi boil is needed, especially with reference to the action of drinking-water, and the nature of the structures that form the essential constituents of the disease.

ANATOMICAL CHARACTERS.—When the Delhi sore is cut into, yellowish points are seen, consisting of minute cellular growths, which have been described by Dr. Smith as the ova of a parasite (*Distoma*), and by others as of vegetable origin, but are probably the result of cell-growth, connected with the hair- and gland-follicles, perhaps an abnormal development of connective-tissue corpuscles, or an imperfect form of granulation. After ulceration has disintegrated the surface, mycelium or other low forms of organism may be present; but it is a question if these be the essential cause, and not rather an accident of the disease, introduced from without. Dr. V. Carter refers Delhi boil to a parasitic organism, consisting of spheroids and mycelium, which occupies the distended lymphatic vessels in and around the sore, arranged in open and angular meshes, the free ends giving off conidia which multiply and reproduce. Pale, round or stellate granulation-cells are found; and numerous bright orange-tinted particles, arranged as spherical or ovoid groups disseminated throughout the tissues of the tumour. These, it is considered, are the fructification-stage of the fungus. Lewis and Cunningham described lymphoid nucleated cells, tho products of a condition which they considered as identical with that of lupus, and which they ascribed to the action of the chemical constituents of certain hard waters; but in a more recent paper, dated 1885, Dr. Cunningham observed, in a specimen of Delhi boil which had not yet ulcerated, certain microscopic bodies, probably zoocysts or sporocysts of some monoclinic origin, which he believes to have been connected with the causation of the disease for more than one reason, the chief being their presence in greater numbers where the greatest morbid changes had taken place, and in the water in certain localities where the disease occurs.

Symptoms.—Delhi sore commences as a small pink and reddish papule, like a mosquito-bite, which gradually extends, generally around a hair-follicle as its centre. This is elevated, and after a time desquamates. There is itching and a stinging sense of pain; on pressure it is somewhat boggy. The progress of the disease is slow, often occupying several weeks, during which time it assumes a semi-transparent appearance, with blood-vessels ramifying near the surface. A vesicle then rises, bursts, and gives exit to an ichor which forms a crust; under this, suppuration and ulceration take place and advance until, by the coalescence of several papules and destruction of skin, an indurated sore is formed, which is either crusted over or fungates. The sore gradually invades the surrounding parts, and, destroying the integument, may give rise, especially on the face, to deformity from cicatricial contraction; and, from the irritation and the pain it causes, may, when the number and extent of the sores are large, seriously compromise the health. An ordinary boil or abrasion may assume these specific characters. The disease is regarded as contagious, and apparently may be produced by inoculation of the specific cell-matter, though not by the pus which forms on the surface.

Treatment.—*Preventive.*—Cleanliness of person, clothing, and habitation, good food, the use of pure drinking-water, and careful attention to the sanitary condition of the locality—avoiding overcrowding and contact with the disease in men or animals,—are the best means of preventing Delhi sore.

Curative.—The most effective measures of a curative kind are—change of locality when practicable; in some cases early destruction of the sore by the potential or actual cautery; the application of metallic astringents, iodine, or carbolic acid lotion; pressure; attention to the state of the health, and any ailment that may be present; tonics and nutritive diet, and especially wholesome drinking-water; and change to another climate.

In the advanced conditions of the disease similar measures are indicated. The sore, if too extensive to be destroyed, should be dressed with stimulating and astringent applications. Soothing measures are indicated if there is pain. Black wash, sulphate and sulpho-carbolate of zinc, copper, Gurjun oil, and lime-water, with change of climate and the use of tonics, will generally prove efficient.

Joseph Fayrer.

DELIRIUM (*deliro*, I rave).—A derangement of consciousness, characterised by incoherence of thought, and evidenced by various expressions and actions. *See* Consciousness, Disorders of.

DELIRIUM TREMENS (*delirium tremens*, trembling delirium).—A form of acute alcoholism, chiefly characterised by delirium and tremors. *See* Alcoholism.

DELUSION (*deludo*, I deceive).—An unfounded belief in regard to some fact or occurrence which almost invariably concerns the patient, and of the falsity of which he cannot be persuaded, either by the evidence of his senses, by his own knowledge and experience, or by the declarations of others. Such delusions, when distinguished from merely erroneous judgments upon complicated or abstract questions, generally indicate insanity. *See* Consciousness, Disorders of; and Insanity.

DEMENTIA (*de*, without; and *mens*, a mind).—Synon.: Fr. *Démence*; Ger. *Blödsinn.*

Definition.—A mental weakness, or a deficiency rather than an aberration of intellect, depending for the most part on some antecedent brain-disorder, such as apoplexy or epilepsy; or being the sequel and termination of various forms of insanity. It may also be congenital, deserving rather the name of idiocy; or it may be due to senile decay.

1. Acute Primary Dementia.—There is a form of insanity known as primary or acute dementia, which comes on rapidly without any preceding disorder, is accompanied by the most profound vacuity and abeyance of all the mental faculties, yet yields to treatment and disappears, leaving the patients sane.

Ætiology.—The patients are young persons, boys and girls,—more frequently girls. The complaint is seldom seen in any case beyond the age of 30, and chiefly in those under 20. It seems to be a collapse of all mental power, due to great physical weakness and deficient nerve-force. Owing to imperfect development, to bad food and living, or to the patients having outgrown their strength, the mental condition becomes so weakened that, with or without some moral cause, as a fright or a scolding or something apparently more trivial, or after some illness slight or severe, they suddenly or gradually present that condition which is now to be described. If the immediate exciting cause is some mental shock or fright, the symptoms may come on rapidly. If they are due to ill-health or some protracted exhausting occupation, the access may be gradual; and if they are set down to sulkiness, temper, or idleness, the measures adopted for the correction of the latter may quickly indicate the real state of things.

Symptoms.—Nothing can appear more hopeless than the appearance many of these patients present. The face is vacant, with a fatuous grin, and often the saliva dribbles continuously. The sufferer sits motionless and lost, or automatically wags the head, snaps the jaws, or moves the limbs for hours together, unconscious of fatigue. Or if a limb is placed in any position, it is retained there for a time in a way that no effort of will could accomplish. There may be a repetition of some word or sentence, but all conversation is abolished, and the patient has to be fed, washed, and tended like a baby.

The physical condition of these patients is peculiar, and corresponds closely to the mental. The heart's action and the circulation are so reduced in strength that the blood in the extremities is stagnant. Hands and feet are blue with cold even in the heat of summer. In cold weather they are covered with chilblains, and great care must be taken, otherwise these will give rise to obstinate sores. The tongue is pale and flabby. The pupils are dilated. There is no rapid emaciation, for the waste here is not great; neither is sleep absent, as in mania, but it is irregular and uncertain.

Pathology.—The external physical manifestations sufficiently indicate the condition of the brain in these patients. It is the very opposite of that in acute sthenic delirious mania. In the latter there is an excessive discharge of nervous force, a hyperæmic state of brain, and rapid brain-circulation; the whole leading in a short time to death by exhaustion, if relief does not come. In acute dementia we see the very opposite. The brain-action is reduced to the lowest point, and the circulation is stagnant, as in the extremities, giving rise to passive congestion and œdema.

Course, Terminations, and Prognosis.—In acute dementia there is no sudden exhaustion; but death, if it occur, is caused, not by the brain-disease, but by a general failure of the bodily strength, or by some low form of lung-disease—phthisis, pneumonia, or gangrene. Death, however, in this disorder, is the exception. When taken in time and properly treated, the majority of these seemingly hopeless cases recover, and recover perfectly.

Treatment.—The treatment of acute dementia may be carried out in a family, or even at home, if means are ample, and if the necessary measures are strictly enforced. But it may be necessary to feed the patient by force, and that for a considerable time, and relations do not always care to enforce this to the extent required. Abundant nutrition is imperatively demanded in order to restore the force that is so greatly in default; and unless abundant nutrition is administered, there will be no recovery, but the patient will die, or sink into permanent dementia. There is not, as a rule, violent resistance to food, but it may be kept in the mouth without being swallowed, and care must be taken in feeding, even if a stomach-tube be not necessary. Food should be given frequently, and so a habit of taking it engendered. Stimulants—wine and brandy—will be necessary, especially in the early stages. Equally necessary is warmth; an amount of heat is required which to those in health would be oppressive, for the greatest heat of summer fails to warm the hands and feet. Warm clothing must be provided, and the circulation aided by a short sharp shower-bath, cold or tepid, and plenty of friction afterwards. Exercise is useful for the same purpose, but this is to be taken under proper supervision, for it must not be fatiguing, and due regard ought to be had to the debilitated state of the individual. In addition to the stimulus of the shower-bath, that of electricity is of great use in acute dementia. Here, and in certain cases of melancholia, marked benefit follows the application of the continuous current. Of drugs the most useful appear to be steel and quinine. The former, in this as in almost every form of insanity, is a most valuable tonic: the choice of the particular preparation should depend upon the state of the patient at the time.

2. **Chronic Primary Dementia.**—Dementia, however, may be primary, yet may not be that just described. It may come on gradually or suddenly, without previous mental affection, but is in such cases connected almost invariably with disease of the brain. Its first and most prominent symptom is loss of memory. In connexion with apoplectic or epileptic attacks, or after years of drinking, the memory is found defective. This loss may appear quite suddenly, or may be noticed to come on gradually, being at first so slight as to cause little alarm. It may vary at different times. If a patient is kept from alcohol, the memory may gain strength; and if epileptic attacks are reduced in frequency, the same thing may happen. The prognosis in all such cases is unfavourable, for loss of memory points to decided deterioration of brain. Apart from loss of memory, symptoms of dementia or weakness of mind are occasionally found as the first indication of mental unsoundness, following a fright or shock or some severe illness. If they assume the form of acute dementia, we may have hopes that they will pass away; but if with little disturbance of the bodily health the mind becomes weaker and weaker, the hopes of recovery are small.

3. **Secondary Dementia.**—Of dementia which is the sequel of prior mental disorder, such as mania and melancholia, little need be said. It varies in degree, but it is not in our power to remove it. It may be in our power, however, to ameliorate in a great degree the condition of such patients when, as is frequently the case, they are found in a very neglected state. Their friends think that nothing can be done or need be done, and they are allowed to lie in bed, often in a filthy condition, or roam about and get into mischief for want of care and skilled

attendance. Many demented patients have far more mind than is generally imagined by the uninitiated, and can be taught to be cleanly, to take their meals in an orderly fashion, and to keep themselves tolerably neat. They are susceptible of amusement, and open to reward for good behaviour. The vital powers of demented patients are low, and they suffer much from cold. In winter their minds, like their bodies, are enfeebled, and with warm weather they recover somewhat of their energy. There is a tendency in many of these patients, especially women, to become very fat, and in this condition they are subject to bronchitis, and may succumb to acute attacks of this disorder. They require warmth and good diet, for it is difficult to make them take sufficient exercise.

Females, in the writer's experience, are more prone to drift into dementia than males. The latter present various types of chronic mania, with well-marked delusions; but, among private patients at any rate, there are fewer of the hopelessly demented than among the female inmates of private asylums. One cause of this may be that the mortality amongst males is greater, and thus fewer are left to reach the demented stage.

G. F. Blandford.

DEMODEX (δημός, fat; and δήξ, a worm).—*See* Acarus.

DEMULCENTS (*demulceo*, I stroke softly).

Definition. — Substances which soften, protect, and soothe mucous membranes. They are generally of a mucilaginous character. When applied to the skin they are termed *emollients.*

Enumeration.—The demulcents in ordinary use are: Linseed-tea, Gum, Starch, Bread, Honey, Figs; Linseed, Almond, and Olive Oil; Glycerine, White-of-Egg, Gelatine, and Isinglass.

Action.—The chief action of demulcents is a mechanical one, in forming a smooth, soft coating for an inflamed mucous membrane, and thus protecting it from external irritation.

T. Lauder Brunton.

DENGUE.—Synon.: Dandy Fever (West Indies); Three-day Fever; Break-bone Fever; Fr. and Ger. *Dengue.*

Definition.—An eruptive fever, considered by many to be infectious; commencing suddenly; and characterised by severe pain in the head and eyeballs, swelling and pain in the muscles and joints—prone to shift suddenly from joint to joint, catarrhal symptoms, sore-throat, congested conjunctivæ, and affection of the submaxillary glands. The disease may remit, and is liable to relapse.

Natural History and Geographical Distribution.—Dengue occurs epidemically and sporadically in India, Burmah, Persia, Egypt and other parts of Africa, North and South America, and the West Indies. Epidemic visitations of dengue, extending over wide tracts of country, occur at considerable intervals, and probably depend on certain unknown atmospheric and cosmic conditions that favour its development.

Ætiology.—Dengue attacks persons of all ages, from infancy to extreme old age. Its infectious character has been deduced from the apparent transmission of the disease from person to person.

Symptoms.—The symptoms characteristic of dengue are the presence of severe continuous arthritic and muscular pains; great debility and prostration; the occurrence of an initial and a terminal rubeoloid or scarlet rash; fever, which is subject to remissions and relapses; the possibility that convalescence may be tedious and painful, and complicated by the continuance of general cachexia, pain and swelling of joints, enlargement of glands, orchitis, weakness of eyes, deafness, visceral disease (such as diarrhœa or dysentery of a chronic and intractable character, and hepatic derangement), boils, carbuncles, and perhaps insanity. In the female, uterine hæmorrhage and miscarriage may occur.

The *invasion* of dengue is usually sudden, the patient feeling well up to the period of attack. The earliest symptom is severe pain in some joint, probably of a finger, which rapidly extends to all the other joints and bones; and this pain during the progress of the disease often passes from one joint to the other by a sort of metastasis. Sometimes there is a period of preliminary malaise, of one or more days' duration, marked by anorexia, a sense of weariness and languor, giddiness, nausea, chilliness or rigor, severe pain in the head or in the eyeballs, and pains in the body, limbs, and joints—notably of the fingers and toes. The attack is often, however, strikingly sudden, as was frequently seen in the late Calcutta epidemic, commencing with violent pains and swelling of the joints, or severe pains in the head, eyeballs, neck, and back. In some epidemics certain phenomena are more prominently marked than others.

The eruption commences on the third day. The fever is accompanied by redness of the face, which is puffy and swollen; sore-throat; congested conjunctivæ; and a general redness, like the scarlatinal rash, extending over the whole body. The tongue is red at the tip and edges, and loaded with white fur, through which the red papillæ protrude. The pulse is rapid, ranging from 100 to 120, or even 140; respiration is hurried; and the temperature rises to 103° or even 105° F. These symptoms mark the occurrence of the initial fever and rash, and endure for a period varying from twenty-four to forty-eight hours. After this the rash disappears; the fever subsides; and the remission lasts for a period of two, three, or four days. A recurrence of febrile symptoms then takes place, accompanied by a second or terminal rash. This differs in character from the first, resembling a rubeoloid or even an urticarial eruption, often showing itself first on the palms of the hands, and in some cases resulting in profuse desquamation of the cuticle, which, however, may sometimes be so slight as to be barely perceptible. These symptoms gradually subside, leaving the patient weak, exhausted, and often still tortured by swelling and pain of the joints, especially the smaller ones, which may continue in this state for weeks, making convalescence tedious and painful. Or there may be repeated relapses, prolonging the suffering and protracting recovery.

Varieties.—The symptoms vary in different cases, as to the character of the rash, the temperature, and the muscular or osseous pains.

The *rash* not only varies considerably in colour, character, and duration, but it is sometimes almost absent; in other cases it is attended with so much hyperæmia and action of the skin that excessive desquamation results. This hyperæmia also sometimes expresses itself by hæmorrhage from the mouth, nose, bowels, and uterus.

The *fever* is sometimes accompanied by delirium, or in children by convulsions; in the latter, indeed, these occasionally initiate the disease.

Dengue occasionally assumes a *malignant* form, where the amount of poison received has been overwhelmingly large. Dr. Charles says: 'Drowsiness may have passed into coma; the temperature verges on the hyperpyrexic; the heart fails, and the lungs are œdematous; while the whole surface is highly cyanotic. These cases have been popularly termed "black fever," and are justly much dreaded.' Happily they are rare. Again, there are very mild forms of the disease, in which the patients are scarcely ill, and where it is not easy to decide as to their exact nature: 'A trifling sore-throat and slight malaise may be all you can lay hold of till the terminal rash appears to show you what you have had to deal with; and even this may not be seen.'

Course, Duration, and Complications.—The period of *incubation* of dengue is probably from five to six days; it may be a day or two more or less in some cases.

In simple and uncomplicated cases the average period for the *duration* of the disease may be taken as about eight days; but it is frequently prolonged over weeks, and recovery is slow and painful; the constitution often being so much shattered that complete restoration to strength and vigour does not occur for months. It is rarely fatal. *Relapses* are liable to be frequent, and the patient may suffer more than even a second or a third relapse before recovery.

Some of the *sequelæ* already mentioned may remain to torture the patient and retard his recovery. Albumen is occasionally present in the urine; but it is not, as in scarlatina, especially in the cases of children, a frequent or dangerous result of the disease.

Diagnosis.—The distinction betwixt scarlatina and dengue is well marked; though during the outset there is considerable resemblance between the two diseases. There is a high temperature at first in both, but it is more quickly attained, and is transient in dengue; in scarlatina it endures for several days, whilst in dengue the fastigium gives a temperature of 103°, or even up to 105° or 107°, and, this being attained, it rapidly declines. It is exceptional to find a temperature above 102° maintained in dengue. In scarlatina the period of decline extends over several days, and is marked by slight exacerbations in the evening. In dengue it occupies a few hours, and the temperature may even fall below the normal. The severe muscular and arthritic pains of dengue do not occur in scarlatina; and the pulse in the latter is much more rapid during the early stages than in the former.

Prognosis.—An attack of dengue does not confer absolute protection from a recurrence of the disease, though it does so to a great extent.

Treatment.—This is a specific fever, and has to run a certain course. The treatment is simple, and if judiciously directed mitigates the sufferings, and materially aids recovery.

Neither emetics nor active purgatives are necessary. They do no good, but increase the weakness and aggravate the suffering by the muscular movements necessarily induced. Moderate action of the bowels is advisable, a warm carminative aperient, or an occasional dose of calomel, rhubarb, or colocynth being administered, especially if the bowels remain confined, to which there does not appear to be any peculiar tendency, though the evacuations may be dark and often slimy, and confined at the outset. Salines, such as the acetate of ammonium, or citrate of potassium, with nitric ether, combined with aconite, are good during the pyrexia. In cases of very high temperature (105° to 107°) Dr. Charles suggests cold sponging as beneficial; he recommends it when 105° is reached. The danger to life of such a high temperature during the intense heat of the hot months in India is great; and it is then that cold sponging or the cold bath is indicated.

Belladonna seems to confer great relief in this disease. Ten to fifteen drops of the tincture may be given; and two or three such doses, at intervals of an hour, will sometimes produce excellent effects, and afford much relief. The extract may be given if preferred, in doses of one-third of a grain; or the juice in similar doses to those of the tincture. For the pains and nocturnal restlessness, morphine or Dover's powder may be given. Liniments containing opium, belladonna, and chloroform are serviceable as external applications to the spine, back, and joints.

Tonics, and a carefully-regulated nutritious diet, are also indicated, and depletive measures must be avoided. The tonics should be of the bitter vegetable kind, such as gentian and calumba; with these may be combined a small quantity of quinine, with a mineral acid; or, in some cases, the dilute phosphoric acid, combined with nux vomica or small doses of strychnine.

Quinine is given more for its tonic than for its antiperiodic effects; though, where there is a tendency to relapses, the judicious administration of five- or even ten-grain doses may be beneficial in arresting them and reducing temperature. Bromide of potassium is recommended by some authorities, and especially when convulsions occur in children. Alkalis, colchicum, and other remedies in use in rheumatism have been found to have little, if any, effect in relieving the pains of dengue.

As to wines, claret is probably the best, but others may be given.

For the irritation of the skin, which is sometimes very troublesome, the application of camphorated oil and the use of warm baths have been suggested.

As in so many other diseases, especially those that occur to Europeans in tropical climates, complete restoration to health is likely to be expedited and promoted by change of air; and if the cachexia be severe after a prolonged attack of dengue, return to the patient's native climate for a season is desirable. JOSEPH FAYRER.

DENTITION, Disorders of.—SYNON.: Teething; Fr. *Troubles de la Dentition*; Ger. *Zahnung.*

GENERAL REMARKS.—The period of cutting the teeth has been always recognised as a critical time, during which the health of young children is especially liable to become disturbed; and it has been a common practice amongst mothers to attribute every illness occurring in early life, from the irritation of scabies to the distortions of rickets, to the same baneful influence. The evolution of the milk-teeth is no doubt attended with some irritation, especially as at this period the follicular apparatus of the intestines is undergoing considerable development; and we know that, on account of the impressibility of the nervous system in young children, any irritation is apt to be followed by general disturbance. It is no doubt also the case that local functional derangements are frequent at this period, but it is often unfair to attribute these *directly* to the irritation of an advancing tooth. One of the most common direct results of teething is pyrexia, which may be intense; and a feverish child is particularly susceptible to impressions of cold, and to the irritation of unsuitable food. Catarrhal attacks coming on at this time need not be therefore the immediate result of the condition of the gum. It is at least admissible to attribute them to the ordinary causes of such derangements, acting upon a body rendered for the time particularly susceptible to injurious influences. This view is supported by the fact that diarrhœa, which is a very common complication of dentition, is especially frequent during the warmer months, when the temperature is apt to undergo rapid variations, while the dress of the child remains unchanged; and is far less common during the winter, when the temperature is more uniform, and the child is more carefully guarded against the cold.

As a rule, the first milk-tooth appears in the seventh month after birth; but dentition may begin at an earlier period. It is not rare for an infant to cut a tooth at the age of four months; and occasionally at the time of birth one tooth is found to be already through the gum. In cases where the ordinary time of teething is anticipated, a pause generally ensues after the appearance of one or two teeth, and further dentition is delayed until the usual age. Constitutional conditions influence the time of teething. Thus tuberculous and syphilitic children cut their teeth early, while in rickety children the teeth are very slow to appear.

In the majority of cases the teeth pierce the gum in the following order: lower central incisors, upper central incisors, upper lateral incisors, lower lateral incisors, first molars, canines, back molars. A child of twelve months old should have eight teeth and be cutting his first molars; and the whole number (twenty) should be through the gums soon after the end of the second year. The order given above is frequently departed from. The incisors, in particular, are often cut irregularly, and it is not rare for the molars also to appear out of their proper order. A double tooth will often be seen to precede the lateral incisors, and may indeed in exceptional cases be the first tooth to appear through the gum. The canines seldom or never precede the first molars.

Some infants suffer more than others from the cutting of a tooth, and it is not always in cases where the eruption of the teeth has been delayed that dentition, when it occurs, is attended with special inconvenience. On the contrary, in severe rickets, where the delay is great, the teeth are often cut with remarkable ease.

The second dentition begins at about the sixth year. The permanent teeth are cut with more regularity than is the case with the earlier crop. The first to be seen are usually four molars, which appear behind the last of the temporary teeth. Next come the central incisors at about the eighth year; the lateral incisors at about the ninth; the first and second bicuspids, in the place of the temporary molars, at the tenth and eleventh; the canines between the twelfth and thirteenth; and the second molars at about the time of puberty. The last four permanent molars are cut later.

Symptoms.—The phenomena which may be looked upon as natural to the first dentition are salivation; swelling of the gum, which becomes more and more tense, hot, and painful; slight general pyrexia, with flushing of one or both cheeks; irritability of temper; and some degree of restlessness at night. These all subside when the point of the tooth appears through the gum. The complications not necessarily attendant upon the process are high fever; inflammation of the mouth and aphthæ; vomiting (gastric catarrh); diarrhœa (intestinal catarrh); cough (pulmonary catarrh); otitis, with purulent discharge from the auditory meatus; various eruptions of the skin, with, sometimes, swelling, and even suppuration of lymphatic glands; and certain troubles of the nervous system, such as convulsions, squinting, &c.

The peculiarity of the pyrexia of dentition is its irregular character. It is often higher in the morning than at night, and varies in intensity in a remarkable manner from day to day. A temperature of 104° F. at 8 A.M. is not at all uncommon in a teething infant; indeed such an amount of fever in the morning should alone lead us to inspect the mouth, as few diseases are marked by so much pyrexia at that hour of the day. It is important in practice to bear in mind this simple cause of elevation of temperature, for any disease in a child is apt to be complicated by teething, and much needless anxiety may be occasioned by overlooking the condition of the gum. We must not, however, in every case where the gums are swollen and tense, rush to the conclusion that they are the sole cause of the symptoms, for the most serious cerebral disease may co-exist with the eruption of a tooth. Thus, to take an example: if we find cerebral symptoms to supervene in the course of dentition, we must most narrowly scrutinise their character, before passing them over as merely harmless indications of the general disturbance. Headache, delirium, vertigo, startings, twitchings, and convulsive attacks, may merely indicate functional disturbance of the brain, such as is common to many disorders, and these phenomena are not necessarily symptomatic of cerebral disease; but if the bowels become obstinately confined, the pulse slow and irregular, and the respiration unequal and sighing; and if in addition there be photophobia, with sullenness and tendency to drowsiness, we may conclude that something more than mere functional derangement is present, and that there is every reason to suspect the existence of tubercular meningitis

In the case of the second dentition there may also be digestive derangement. During this period the child is subject to gastro-intestinal catarrhs, which give rise to looseness of the bowels. He is often irritable in the day and restless at night. Night terrors are common, and he may wake up from his sleep screaming with fright at some horrible dream. Besides the discomfort due to fermentation of food and acidity, considerable loss of flesh may be the consequence of digestive derangement if long continued.

Treatment.—The treatment of the complications which occur during dentition must be conducted upon ordinary principles. Aphthæ of the mouth are readily cured by the administration of rhubarb and soda, and the application to the mouth of a solution of chlorate of potassium or borax (ten grains to the ounce) in water, and sweetened with glycerine. Perfect cleanliness is necessary, and the child's mouth should be washed out each time after taking food with a piece of soft rag dipped in warm water.

Vomiting is best checked by clearing out the stomach with an emetic of ipecacuanha wine, giving a tea-spoonful every ten minutes until sickness is produced. Afterwards, a few grains of bicarbonate of sodium may be given with one drop of liquor arsenicalis in a teaspoonful of water three times a day. Diarrhœa should be treated on the same principle: first a dose of castor oil to remove irritating products from the bowels; then a mixture containing chalk and catechu, or oxide of zinc (one grain to the dose). If afterwards the motions continue large, pasty-looking, and offensive, and are passed too frequently in the day, one drop of tincture of opium may be added to the mixture, as there is usually in such cases too rapid peristaltic action of the intestines. In the case of either of these derangements (vomiting or diarrhœa), it is of great importance to keep the body warm, and this is most effectually done by applying a broad flannel bandage to the abdomen. The diet also should be temporarily modified, reducing the quantity of farinaceous matter that is being taken, on account of the tendency to acid fermentation of food which is set up by such a condition of the alimentary canal.

Looseness of the bowels during dentition has been looked upon by some writers as a natural method of relief to the system, and fears have been entertained of grave troubles which might ensue if the looseness were too suddenly arrested. Such fears are, however, quite groundless. A catarrhal condition of the bowels should be cured as quickly as possible, especially during dentition, for at this time the susceptibility to chills is heightened, and the danger of severe diarrhœa being set up correspondingly great. In some cases of teething, where the lungs as well as the bowels are the seat of catarrh, and there is a risk of bronchitis, Trousseau recommends that the intestinal derangement should not be suddenly put an end to; but even in these cases a dose of castor-oil may be safely given, to remove irritating matters from the canal, for, according to the writer's experience, any irritation of the bowels is apt rather to increase than to diminish pulmonary mischief.

The favourite remedy for all disorders occurring at the time of dentition is lancing the gums, but the practice is one which ought not to be pursued indiscriminately. Unless the gum be actually swollen and tense, incising it has no object whatever, for to cut the top of the gum can have no influence in promoting the development of the tooth below. If, however, there be very much inflammation and swelling, and the child seem to be in pain, relief may be obtained by lancing, but in this case the object is merely to relieve tension. Excitement of the nervous system dependent upon the condition of the mouth can perhaps be allayed by the same means; but in the case of convulsions more benefit is to be gained by the use of warm baths, cold applications to the head, and the gentle action of a mild alterative aperient.

In the second dentition, care should be taken to keep the child's feet warm and his body properly protected from cold. Attacks of indigestion and diarrhœa must be treated by suitable remedies, and attention should be paid to the diet, limiting the quantity of starches and sweets allowed, on account of the tendency to fermentation and acidity. Night terrors, which are merely attacks of nightmare, can be cured at once in children by a mild aperient to clear away undigested food from the bowels, and by a careful diet. Sweets, starches, and fruit should be forbidden; and the child must be fed on meat, fish, poultry, milk, butter, cooked green vegetables, eggs, stale bread, and any kind of non-fermentable food suited to his age. EUSTACE SMITH.

DENVER, in Colorado. — Situated 5,200 feet above the sea, on a plain backed by the Rocky Mountains. A dry, cold, clear, and bracing climate. Diathermancy considerable. Temperature: mean daily range, 24° F., showing great variation; mean temperature, 49°. Rainfall, 15 inches. A valuable high-altitude station for phthisical patients. Railway communication and accommodation excellent. For invalids the suburbs of Denver are preferable to the city itself.

DEOBSTRUENT (*de*, from; and *obstruo*, I obstruct).—A measure which removes obstructions, such as an aperient; or which opens the natural passages or pores of the body. *See* PURGATIVES; and DIAPHORETICS.

DEODORANTS (*de*, from; and *odoro*, I cause to smell).

DEFINITION. — The term 'deodorant,' although it has a more extended signification, is generally used to signify a substance that destroys offensive odours.

GENERAL PRINCIPLES.—Odorous bodies are essentially volatile, and those which are offensive frequently contain sulphur in some state of combination. Deodorants usually produce the effect for which they are used by causing a chemical change in bodies to which they are applied; but sometimes their action consists in absorbing and condensing odorous substances, and thus destroying or counteracting their volatility. Substances which, like charcoal, possess this latter property may, however, indirectly produce chemical changes by bringing the odorous substances into contact with oxygen in a condensed and active condition.

Deodorants may be classed as *volatile* and *non-volatile*.

1. Volatile Deodorants. — These all consist of substances the action of which is immediately and exclusively chemical. Being intended to act on bodies which are themselves volatile, they admit of more generally useful application than those which are not volatile.

ENUMERATION. — Chlorine and its lower oxides, Sulphurous Acid, Nitrous Acid and other oxides of Nitrogen, Ozone, and Peroxide of Hydrogen, are the most important members of this class.

APPLICATION.—In the selection and use of volatile deodorants, it is necessary to distinguish between bodies which possess the power of destroying or removing a noxious smell, and those which merely cover one smell by another. Carbolic acid, for instance, which is a valuable disinfectant, is of little use as a deodorant, although its powerful odour may render other weaker but more objectionable odours imperceptible or indistinguishable. On the other hand, the so-called chloride of lime (chlorinated lime of the Pharmacopœia), while it possesses a strong and characteristic smell itself, is capable of destroying other noxious odours, and is an excellent deodorant.

The chemical action by which noxious odours are destroyed is principally one of oxidation, and therefore the agents forming this class of deodorants are generally oxidising agents. Ozone, or active oxygen, is the natural deodorant contained in the atmosphere, which no doubt largely contributes to the destruction of noxious vapours in the air. Volatile oils, which emanate from the flowers and other parts of plants, in contact with atmospheric oxygen produce peroxide of hydrogen, and this as an oxidising agent possesses deodorising as well as disinfecting properties. The moderate and judicious use of perfumes may thus produce a beneficial effect, although their undue employment, by hiding rather than removing what is objectionable, may be injurious to health, and cannot be recommended. The preparation called 'Sanitas' is principally a solution of peroxide of hydrogen.

2. **Non-volatile Deodorants.** — Enumeration.—Among this class of deodorants are included Charcoal, Earth, Lime, Oxide of Iron, Sulphate of Iron, Chloride of Zinc, Nitrate of Lead, and Permanganate of Potassium.

Application. — Although very efficient when brought into contact with the class of odorous substances referred to as noxious gases, these deodorants are less generally useful than they would otherwise be on account of their non-volatile character. Charcoal owes much of its efficacy as a deodorant to the surface-attraction and power of condensation which it possesses, by virtue of which it brings noxious gases, such as sulphuretted hydrogen, into contact with oxygen in a condensed and active state, so that they are burnt up and resolved into innocuous compounds, or compounds less noxious than those from which they are produced. Earth and oxide of iron, which, like charcoal, are used in the solid and dry, or nearly dry, state, absorb and combine with, or promote the combination of, noxious gases, producing innocuous products. Lime may be used either dry or in the state of milk of lime. The other substances named are used in the form of solution in water. Where large quantities of decomposing animal or vegetable matter are required to be deodorised, dry lime or solution of sulphate of iron (green vitriol) may be economically and advantageously used. T. Redwood.

DEPILATORIES (*depilis*, without hair).—Synon.: *Psilothron*; *Rusma*.

Definition.— Depilatories are measures used for the destruction of superfluous hairs.

Hypertrichosis.—The patients who present themselves for treatment by depilation are, of course, almost always women. In the immense majority of cases the disfiguring hairs are on the upper lip, chin, neck, or in front of the ears, the annoyance and mental depression caused by them being often so extreme as to justify any procedure likely to give permanent relief, provided it is rationally employed and its limitations are properly understood. It must be carefully borne in mind, however, that in a certain number of cases hypertrichosis is only temporary, dependent perhaps on pregnancy or menstrual disorders, or associated with acne and other sebaceous affections; and that in these circumstances it may disappear spontaneously, or as the result of treatment directed to these associated conditions. As a rule, the disfigurement is first noticed at about the age of eighteen, and is progressive till twenty-five or thirty, after which it remains permanent till the menopause, when it frequently becomes aggravated.

Enumeration.— Various caustic applications are occasionally used as depilatories. Sir Erasmus Wilson recommended the following:—Quicklime (three parts), sulphide of sodium or of barium (one part), diluted with starch (four parts). The powder, mixed with water to the consistence of a thin paste, is laid on the affected part by means of an ivory paper-knife, and allowed to remain for from five to fifteen minutes. It must then be carefully scraped off, when the hair, shrivelled and burnt, comes away with it. The skin must then be washed with water, dried, and anointed with cold-cream.

Although the immediate result of this method is sometimes satisfactory, a troublesome degree of dermatitis is generally occasioned by it. The hairs, too, always return, their roots not being destroyed, but only stimulated by the treatment; and the subsequent growth is invariably stronger, darker, and more disfiguring than the original, while considerable scarring too frequently results.

Many women keep the disfigurement due to hypertrichosis in abeyance by habitually extracting the hairs with forceps. There are many obvious objections to the procedure, but in some cases, where no other treatment is applicable, it answers fairly well; as its result, however, the growth becomes darker, stronger, and more bristly. In a certain number of cases good cosmetic results are obtained by bleaching the hair with a saturated solution of peroxide of hydrogen.

Depilation by Electrolysis.—The only efficacious and permanent method of destroying superfluous hair is by electrolysis. First practised by Michel, of St. Louis, U.S., in 1879, subsequently by Hardaway, G. H. Fox, and other American dermatologists, it has of late years been introduced to the continent of Europe and to this country, where, however, owing to its indiscriminate employment, too often by unscientific persons, the treatment appears likely to fall into unmerited discredit.

Indications. — Generally speaking, the cases in which electrolysis is most applicable are those where—(1) the growth is limited in extent, and stationary, not progressive; (2) the hairs are strong and dark; (3) the amount of downy undergrowth is slight; (4) the patient stands pain well, is sufficiently intelligent to understand the bearings and restrictions of the process, and is in a position to submit to its necessarily protracted duration. There is little doubt that downy hairs in the regions operated upon sometimes become dark and strong with undue rapidity as the result of electrolysis; but it is also more than probable that, independently of it, these hairs would ultimately, although more slowly, become sources of disfigurement. The writer is of opinion that cases in which the growth is most abundant upon or confined to the upper lip—and, unfortunately, they form a considerable proportion of those who present themselves for treatment—are, as a rule, unsatisfactory, owing to the large number of hair-follicles there present, the extreme sensitiveness of the part, the small number of hairs which can be extracted at a sitting (seldom exceeding twelve to fifteen), and the amount of inflammatory œdema set up in the lax tissue.

Apparatus.—The necessary apparatus for depilation by electrolysis comprises—(1) a reliable constant-current battery of from ten to twenty cells, the nature of the elements being a matter of indifference; (2) an absolute dead-beat galvanometer, graduated in milliampères, and preferably incorporated with the battery; (3) long, light, pliable rheophores; (4) a suitable needle-holder, connected with the negative pole of the battery, many forms of which are now made (those which have the current-interrupting apparatus in the handle are clumsy and inconvenient); (5) a fine needle made of steel or platinum, or of gold or platinum tipped with iridium—(the writer, after giving all these a fair trial, has reverted to the finest steel sewing-needles—Abel Morrall's 12's, the only disadvantage of which is their brittleness); (6) a carbon or brass cylinder covered with chamois-leather, constituting the positive electrode, and connected with the positive pole of the battery. A steady hand and good vision are indispensable on the part of the operator, all suggested arrangements of magnifying-glasses being unsatisfactory. The best of such is a watchmaker's glass mounted on a spectacle-frame.

Method.—The patient being placed in a good light, and preferably in the recumbent posture, the needle is introduced into the hair-follicle for a distance of $\frac{1}{16}$ to $\frac{1}{8}$ of an inch or more, the follicle being, as it were, catheterised. The experienced touch is even able to distinguish when the bottom of the follicle is reached, by a slight increase in the resistance encountered. The current is closed by the patient firmly grasping the positive electrode, previously well soaked in warm water, and a sharp pain is experienced at the moment of closure, which persists, but in a modified form, throughout the destruction of the hair. The hair may then be seized with forceps, held in the left hand; and, when destroyed, it comes away without appreciable traction. The current is then broken by the patient relaxing the grasp of the positive electrode, and the needle is withdrawn. Whilst the current passes, a little froth, evidence of the electrolytic action, wells up by the side of the hair, and an urticarial wheal forms. This soon subsides, leaving a pink, hardish papule, which lasts a few days; whilst occasionally a minute scab forms, which may take about a week to separate. In either case a tiny white depressed scar is left, but it is usually practically imperceptible after a short time. Occasionally, however,—especially in persons of dark complexion—the scars are rather deeply pigmented, and the resulting disfigurement disappears but slowly. A current of five milliampères employed for half a minute is sufficient to destroy the strongest hairs, if the follicle is accurately struck; and from six to ten cells are usually sufficient to generate this current strength. Weaker currents are effectual in destroying finer hairs, but it is strongly inadvisable to attempt to destroy lanugo. The amount of pain experienced varies within very wide limits; it is seldom so intolerable as to contra-indicate the operation. In some cases ointments containing 10–20 per cent. of cocaine, rubbed in for ten minutes beforehand, diminish it sensibly. The number of hairs extracted at a sitting ought never to exceed fifty, and an interval of several days ought always to be observed between the destruction of hairs close together. A few recurrences necessarily take place, their number being in inverse ratio to the expertness with which the operation has been performed. They are easily recognisable, and are generally most abundant beneath the chin and on the neck, where it is difficult to determine the precise direction of the hair-follicles.

It is impossible here to dwell upon all the details of the procedure, the success of which mainly depends upon skill, patience, and experience. J. J. Pringle.

DEPLETION (*depleo*, I empty out). Synon.: Fr. *Déplétion*; *L'Action de vider*; Ger. *Entleerung*.

Definition.—By the term 'depletion' is understood: (*a*) the unloading, or rendering less full, of that which is over-burdened or over-full, for example, portions of the turgid vascular system—as the portal vessels; or (*b*) excessive evacuation, causing exhaustion —as in choleraic or other severe diarrhœa.

Uses.—Depletion, local or general, as a therapeutic agent, may be practised in a variety of affections, such as cerebral congestion, venous turgescence, engorgement of the portal system, pulmonary congestion, renal ischæmia, aneurysm, or general plethora.

Methods.—The agencies whereby depletion may be produced are blood-letting, general or local; purging; vomiting; sweating; and abstinence from food and drink.

1. General Blood-letting.—There is no more powerful or prompt depleting agent than general blood-letting by venesection or arteriotomy. Indeed, the chief indications for bleeding are to be found where it serves a depleting purpose—*e.g.* in engorgement of the right heart and venous system as a result of disease of the heart itself, or from disease of the lungs or from impaired respiratory movement; also in visceral congestion and arterial turgescence (*see* Blood, Abstraction of). It is seldom, however, that abstraction of blood needs to be carried to such an extent as to exert a marked depleting effect on the whole system; it is required, rather, for the relief of limited vaso-motor disturbances.

2. **Local Bleeding.**—Bleeding by means of leeches, scarification, or cupping, may serve a very valuable depleting purpose in limited congestions, as in those of the pericardium, pleura, peritoneum, lungs, eyes, kidneys, tongue, uterus, and hæmorrhoidal vessels.

3. **Purgation.**—For general depleting purposes free purging by means of hydragogue cathartics is a most efficacious agent. When it is required to give relief to turgid vessels without abstracting blood in cerebral, cardiac, and hepatic congestions, nothing depletes so readily, efficiently, and safely as watery purges. The best purgatives are elaterin, jalap, senna, scammony, sulphate of magnesium or sodium, tartarated soda, acid tartrate of potassium, croton oil, and gamboge; to which list may be added mercury, antimony, and resin of podophyllin. The great advantage of hydragogue purges is that they deplete by removing serum from the blood-vessels without the loss of red corpuscles. Depletion by means of such purges is of cardinal service in cerebral congestion. In congestion of the intestinal tract arising from hepatic, cardiac, or pulmonary disease, a mercurial followed in a few hours by a saline purge is of great service. Antimony has been mentioned in the above list because of its usefulness in combination with sulphate of magnesium and other saline purges. As it also acts as a powerful circulatory depressant, we should remember that it can be only employed when such action is permissible.

4. **Vomiting.**—Antimony, when used as an emetic, has a powerfully depressant, as well as evacuant or depletory effect; but depression and depletion are not synonymous. The lowering effects of free purging are pronounced, and, ordinarily, sufficient. Emetics may act as depletants by evacuating the contents of, or producing a flux from, the stomach and intestine; but when used with this object their depressant action is always to be borne in mind.

5. **Sweating.**—Sweating is a less effectual method of depletion, but if freely induced may, as in cases of renal disease, serve a good purpose in lowering arterial tension and assisting the elimination of retained materials. The usual modes of exciting diaphoresis are active exercise, the hot air (or Turkish) bath, the vapour bath, wet packing, nitrate of pilocarpine (jaborandi), antimony, Dover's powder, and spiritus ætheris nitrosi, or a judicious combination of these measures. Copious draughts of hot liquids often aid the action of diaphoretic remedies. The evacuant action of sweating and purging may be advantageously combined when speedy depletion is desired. The combination is valuable in certain dropsies. *See* Dropsy.

6. **Abstinence.**—General depletion may be produced by abstinence from food and drink, and this method is sometimes employed in the treatment of aneurysm.

Alfred Wiltshire. John Harold.

DEPOSITS.—The term 'deposit' had at one time a much wider extension in pathology than it has now. In accordance with the doctrine of morbid *crases* or *dyscrasiæ*, it was customary to regard cancers and all new growths, the products of tubercular and scrofulous diseases, as well as those of the specific fevers and ordinary inflammation—in fact, almost every kind of morbid product in the body—as 'deposited' from the blood in consequence of some alteration in its composition (*see* Blood-disease). In many of theso cases the term *deposit* is still often used, even though an entirely different view may be taken of the processes leading to these morbid changes. The name remains, though the idea has departed; and this is also true of other morbid products called 'deposits.' The term *secondary deposits* was formerly used for what are now called pyæmic or secondary abscesses, from a belief that pus was removed from the original seat of disease, and deposited in distant parts. The term *atheromatous deposit* is due to Rokitansky, who described this change as due to the deposition upon the arterial wall of material precipitated from the blood. In both these cases the term seems now misleading. Again, several processes which we now call degenerations or infiltrations were formerly spoken of as deposits; for example, lardaceous, fatty, and pigmentary deposits; and although these processes may now be better described by another name, it cannot be doubted that in some of them an extraneous substance is actually deposited in the tissues. The term *fibrinous deposits* was also used for the masses now known as infarctions or blocks (as for example in the spleen or kidneys), where the appearance of a mass of extraneous material is produced by the degeneration as a mass of tissue, mixed with products of hæmorrhage, inflammation, and exudation. In quite another sense the various substances precipitated from urine are spoken of as *urinary deposits*, with which we are not here concerned.

When these exceptions are made, the present use of the word *deposit* is a limited one, but is appropriate in those cases where something different from the elements of the tissue, and especially if it be an inorganic material, is found in their substance, and when it may reasonably be supposed that this material has been brought to the tissues by the circulating fluid and there deposited. The term is clearly inappropriate when the foreign matter is formed by some chemical change in the substance of the tissue-elements; but between such cases and those just mentioned it is very difficult to draw the line. We shall speak, in the sense just defined, of *calcareous*, *metallic*, and *pigmentary* deposits.

1. **Calcareous Deposits.**—All calcification of the tissues of the body, whether normal or degenerated, of inflammatory products, of new-growths, or of any other morbid products, appears to depend upon the deposition of lime-salts in the form of granules, this deposition taking place either within the substance of the elements, or more rarely in the intercellular substance, or, possibly, sometimes in the interstices of the tissue. Calcareous deposit takes place towards the close of life in several parts of the body, as in the walls of arteries, in cartilages and tendons, in the valves of the heart, and the crystalline lens of the eye; though in most of these cases, if not in all, some other pathological change precedes the deposition of lime. Still more frequently this change occurs in masses of dead or degenerated materials, as, for instance, in organs which have partially or wholly lost their vitality, in new-growths which have reached the stage of retrogressive change, in old blood-clots, or in products of bygone inflammation. A wasted eyeball always becomes partly calcified (sometimes ossified); tumours, such as myoma and fibroma, are especially subject to calcification; venous clots which remain long undisturbed, as in the deep veins of the pelvis, undergo the same change, and become phlebolites. Old inflammatory products, as pus and lymph, seem to become necessarily calcified if they are not absorbed; so do especially the products of chronic degenerative inflammations which have become necrotic, as seen in scrofulous lymphatic glands, and in tubercular masses in the lungs. A similar explanation applies to calcareous deposit in the walls of arteries, where the lime is generally deposited in new products which result from chronic arteritis or the atheromatous process, though lime may also be deposited in the muscular walls independently of atheroma. Necrotic masses resulting from embolic infarction are frequently calcified. Parasites of all kinds, occurring in solid organs, are liable to become surrounded by a calcified wall; a change frequently seen in hydatid cysts.

From all this it appears that calcareous deposit rarely occurs in normal healthy tissues, but is common in such parts as are dead or of deficient vitality. Its deposition must be attributed to some chemical reaction between the tissues thus altered and the lime-salts in the blood; and it is possible that the presence of an excessive quantity of lime-salts in the blood sometimes favours the change, since deposition of lime in one part sometimes coincides with removal of it from another part. In senile decay the wasting of bones goes on simultaneously with the calcifying processes just mentioned, and in some rare cases rapid absorption of bone from special disease has appeared to be the determining cause of its deposit elsewhere by a sort of *calcareous metastasis.*

2. **Metallic Deposits.**—Other minerals besides lime-salts are rarely found deposited in the tissues, although in cases of chronic metallic poisoning, compounds of lead, silver, and copper may be found thus deposited. Zinc and mercury are less clearly traced, but probably follow the same law. The state or chemical combination in which the metals occur is not positively known, but appears to be some combination with albumen.

3. **Pigmentary Deposits.**—Pigmentation as a process is discussed in the article Degeneration, and has been shown to depend very frequently upon the occurrence of hæmorrhage and transformation of the extravasated blood. But physiological pigment, or melanin, is deposited in many parts of the body, both normally and pathologically, quite independently of hæmorrhage. Normally this is seen in the skin, the choroid coat of the eye, &c.: pathologically in the same situations, but in excessive quantity; and also in abnormal situations, as on the mucous membrane of the mouth. The arrangement of the pigment is in every case the same, forming minute black granules in the protoplasm of the cells around the nucleus. Its deposition and removal are regulated by causes as yet very imperfectly known, but are probably in some way dependent upon the nervous system.

The deposit of such substances as fat, lardaceous material, colloid, &c., is not a simple process, but depends either upon chemical metamorphosis of the cell, or on general pathological changes, which are dealt with in other parts of this work.

J. F. Payne.

DERBYSHIRE NECK.—A synonym for goître, which is thus called from the prevalence of the disease in that county. *See* Goître.

DERIVATIVES (*derivo*, I drain).

Definition.—Medical appliances or remedies which lessen a morbid process, such as inflammation, in one part of the body, by producing a flow of blood or lymph to another part.

Enumeration.—Derivatives include Local Bleeding, Cupping, Leeches, Blisters, Sinapisms, and Setons.

Action.—The name 'derivative' was applied in ancient times under the belief that diseases were caused by morbid humours, which might be drawn away from the part which they were affecting. It is now used chiefly to signify the diminution of blood in an inflamed part, by increased circulation in some other vascular district, either adjoining or remote from it.

T. Lauder Brunton.

DERMATALGIA (δέρμα, the skin; and ἄλγος, pain).—Pain and aching in the skin. *See* Neuralgia.

DERMATITIS (δέρμα, the skin).—Inflammation of the skin: a term applicable to every variety of inflammation of the integument, but especially to an acute inflammation attended with exfoliation of the cuticle and copious desquamation — for example, *dermatitis exfoliativa*, the *pityriasis rubra* of Devergie.

DERMATOLYSIS (δέρμα, the skin; and λύσις, a loosening).—Looseness or relaxation of the skin. *See* Molluscum.

DESQUAMATION (*de*, signifying separation; and *squama*, a scale).—The process of separation or shedding of the epithelium of any surface. It is of most importance in connexion with the skin in scarlatina, where the epidermis usually desquamates extensively.

DESQUAMATIVE NEPHRITIS.—A synonym for certain forms of Bright's disease, applied on account of their being characterised by shedding of the epithelium lining the tubules. *See* Bright's Disease.

DETERGENTS (*detergo*, I cleanse).

Definition. — Substances which cleanse the skin.

Enumeration.—The principal detergents are—Water, Soap, Alkalis, Ox-gall, Milk, Vinegar, Alcohol, Charcoal, Sand, Oatmeal, Sawdust, Pumice-stone, Oil, and Borax.

Uses. — Detergents are used to remove either extraneous dirt adherent to the skin, or epidermal scales which have accumulated upon it and interfere with its function. The chief detergent is warm water, but its action is greatly aided by such substances as soap, alkalis, borax, or vinegar, which act chemically in the removal of dirt or epidermis; or by such substances as oatmeal, sawdust, charcoal, pumice-stone, and sand, which act mechanically. Oil, or alcohol in the form of *eau de Cologne*, removes the resinous deposit left on the skin by plasters. Where the skin is tender, as in the case of the scalp, and where at the same time the detergent employed cannot very readily be removed, borax with elderflower water may be found preferable to the more irritating soaps as a means of removing scurf.

T. Lauder Brunton.

DETERMINATION OF BLOOD.—Increased flow of blood to a part or organ: synonymous with *active hyperæmia* or *active congestion*. *See* Circulation, Disorders of.

DEVELOPMENT, Arrest of.—The causes of arrest of development are in most cases still very doubtful, and for the most important theories and observations on the subject the reader is referred to the article on Malformations. Such arrests may take place at any stage in the development of the embryo and of its organs; but only the most important of them, and the mode in which some typical examples are brought about, will be mentioned here.

Varieties.—Those which occur very early in fœtal life are complex and, for the most part, incompatible with viability; whilst those which occur later often affect only one organ or a set of organs, and in some cases form no barrier to a prolonged existence. Not only must the fœtus be considered, but also the placenta and membranes in which it is enclosed *in utero*; for diseases of these lead to many forms of monstrosity, either by interference with the nutrition and respiration of the embryo, as in the case of many so-called 'true moles'; or the normal changes may be checked by adhesions between them and the fœtus. Persistence of the umbilical vesicle is excessively rare, but a patent vitelline duct is not uncommon, and explains many of the diverticula in connexion with the small intestines. A want of closure of the visceral laminæ is the source of many deformities, from a simple fissure in the sternum, or a ventral hernia, to a complete anterior cleft, with the thoracic and abdominal viscera lying bare out of the body-cavity. In other cases the skin and muscles only may cover the viscera, or the muscles may not be developed. The thorax is closed before the abdomen, so that ectopia of the abdominal is more common than of the thoracic viscera. The abdomen, however, is sometimes closed in whilst the thorax remains open, and varying degrees of ectopia cordis result; but this is rarely complete. Epispadias and hypospadias to varying extents are further examples of imperfect fusion of the ventral laminæ. These may or may not be attended with displacement or deficiency of the urinary and genital organs. Similarly, from an incomplete fusion of the vertebral laminæ, the various forms of spina bifida occur; and these are generally accompanied with an excess of fluid in the spinal canal, or hydrorachis.

The arrests in the development of the cerebro-spinal centres and of the organs of special sense are very numerous. The whole brain may be wanting, or the medulla oblongata may be developed and the remaining portions missing, or any part of it may be absent or quite rudimentary. From incomplete fusion of the bones of the skull hernia cerebri or encephalocele occurs, and this is generally complicated with hydrocephalus, though the latter is frequently found as an independent and solitary affection. Coloboma and deficiency of the olfactory, optic, or auditory nerves are well-known examples of arrested development of the organs of special sense. The special malformations of the heart and vascular system, the digestive, respiratory, and urino-genital systems, will be found described under the various organs; but reference must here be made to congenital fissures leading into the pharynx (persistent branchial clefts), to the various fissures of the face and palate, to persistent cloacæ, to the numerous forms of hermaphroditism, and to imperforate anus, as all coming under this head. Varying degrees of ill-developed extremities are common, from a diminution of number in the fingers or toes, or their coalescence, to a complete absence of one or all the limbs. Finally, ducts, vessels, and openings—such as the urachus, ductus arteriosus, umbilical vessels, and foramen ovale—which normally close soon after birth, may remain patent throughout life. JOHN CURNOW.

DEVONSHIRE COLIC.—A synonym for lead colic, which has arisen from the frequency of lead-poisoning in that county, supposed to be due to the contamination of cider with lead. *See* LEAD, Poisoning by.

DIABETES INSIPIDUS (*διαβαίνω*, I walk with the legs apart; *διαβήτης*, a thing with outstretched legs, a pair of compasses, a siphon—whence the idea of free flow is derived; *insipidus*, tasteless).—SYNON.: Polyuria; Fr. *Diabète insipide*; *Diabète non sucré*; Ger. *Polyurie.* A synonym for polyuria. *See* POLYURIA.

DIABETES MELLITUS (*διαβήτης*; and *μέλι*, honey).—SYNON.: Glycosuria; Fr. *Diabète*; Ger. *Harnzuckerruhr.*

DEFINITION.—The term Diabetes, meaning an excessive flow of something, has been applied to the pathological condition indicated by an excessive flow of urine. It has, moreover, been almost wholly limited to the kind of malady characterised by the presence of a notable quantity of sugar in the urine—a condition more strictly described by the term Diabetes Mellitus. Another condition is sometimes seen where no sugar is to be found in the urine, which is, however, excessive in quantity. This is designated Diabetes Insipidus, or (better) Polyuria.

Diabetes is a malady more or less chronic, characterised by the persistent presence of a notable quantity of sugar in the urine, which is in most cases markedly abundant. It is accompanied by thirst, hunger, and bodily wasting. If unrelieved, it invariably tends to death. The ordinary form of diabetes is thus to be distinguished from certain other conditions, where, for instance, a small, or hardly perceptible trace of sugar may be detected in the urine; or where, yet again, considerable quantities of this substance may be detected occasionally, and for a short time only. To this abnormal condition the term *glycosuria*, which is often also employed to describe artificial diabetes, best applies.

GENERAL CONSIDERATIONS.—Three important facts lie at the bottom of our knowledge of the pathology of diabetes. These are:—

I. That grape sugar is found in the healthy human body.

II. That glycogen, a substance closely allied in chemical composition to grape sugar, is also found in the healthy human body.

III. That both of these may be formed in the healthy human body.

Beyond these, certain other fairly definite propositions may be made:—

1. Glycogen is found most abundantly in the liver, insomuch that, with due precautions, it can always be detected there: after a certain time sugar takes the place of glycogen, but the exact mode and time of this conversion are not known.

2. Nevertheless, it is fairly certain that the sugar called glucose can always be detected in the liver; still more certain that it is to be found in the blood; but

3. This sugar never appears in any notable quantity during a state of health in the urine.

4. As sugar is not to be found in any appreciable quantity in any other of the excretions, it follows:

5. That this sugar must disappear in the body.

6. It is commonly asserted, and, upon the whole, believed, that sugar is less plentiful in venous than in arterial blood.

7. From this, if true, it follows that sugar must be used up in the course of the circulation.

8. Where the combustion, or oxidation, occurs is not quite clear.

9. But it is plain that, from a fault in either direction, sugar may become over-abundant in the blood, namely:—

(*a*) *By over-production*, or

(*b*) *By diminished consumption.*

10. The over-production and the diminished consumption of sugar in the body may depend on various causes. The most notable of these are (*a*) an increased ingestion of saccharine material into the stomach and bowels, without a corresponding destruction; and (*b*) such an alteration of nerve-influence as will completely modify the relative proportions of the sugar produced and the sugar destroyed.

11. With an excess of sugar in the blood, only one easy road of egress from the body is available, that is, by way of the kidneys; but this is not a sufficient outlet when there is great superabundance in the blood. Sugar

may then be found in almost every one of the secretions or excretions.

12. With this unnatural discharge of sugar there is usually a corresponding discharge of urine, but not always.

13. Thus there may be no greatly increased flow of urine, yet the urine may be rich in sugar.

14. And yet, again, there may be a copious flow of urine without any sugar, as in *polyuria*.

15. Hence the over-production or the diminished consumption of sugar in the system has no necessary connexion with increased flow of urine.

16. Both the abnormal action of the liver and that of the kidneys seem in the main to depend on similar but not identical causes.

17. Both seem to be under the control of the sympathetic, but the special fibres are not the same as regards the two organs.

(*a*) In the case of the liver, the fibres seem to originate in the medulla oblongata, to descend in the spinal cord to the lower cervical or upper dorsal vertebræ, thence to leave the cord to join the gangliated sympathetic, and so ultimately to reach the liver.

(*b*) In the case of the kidneys, the active fibres proceed further down the spinal cord, but are ultimately connected with the great abdominal plexus, for such it may well be called, whence the fibres proceed to the kidneys.

Ætiology.—The classification of cases of diabetes according to causation is in very many cases practically impossible.

As to the circumstances that call the morbid processes into play, we know very little. It is certain, however, that the disease is much more frequent among men than among women, and among the middle-aged than among the very young or the very old. The disease is very much more fatal in young adults than in those over, say, forty-five. That the disease is more rife in certain districts than in others may probably be best explained by its undoubted tendency to heredity. This heredity, as in many other maladies, is peculiar; the diabetic tendency in one branch of a family being represented in another branch by various nervous disorders, especially epilepsy and imbecility.

Of the so-called *exciting* causes there are two of the first rank, namely, injury or disease of the brain; and mental excitement, or, perhaps still more, worry. Tumours and other local brain-mischiefs sometimes give rise to a fatal diabetes. Certain mental emotions, at once powerful and prolonged, which may be epitomised in the single word 'strain,' apparently act as exciting causes of diabetes, such as continuous anxiety, long-lasting grief, or excitement followed by reaction. Certain errors of diet—such as excessive use of hydrocarbons, especially sugar, or other interference with the laws of health, may originate a fatal diabetes, especially in those who have any hereditary tendency to the disease. It is possible that the frequency of the malady among the Jews (as noted by Seegen) may be accounted for on dietetic grounds.

Anatomical Characters.—Many pathological conditions have been recorded as occurring in those who had been the subjects of diabetes, but we know little of its real pathology. In many cases nothing which can be directly connected with the diabetes has been found *post mortem*. Latterly attention has been mainly directed to the investigation of certain parts of the nervous system and of the liver itself. Perhaps the most reliable data for the ordinary anatomical appearances are to be found in Seegen's analysis of Rokitansky's experience, embracing 30 necropsies.

Connected with the *brain and spinal cord* various lesions have been found, such as tumours of different kinds pressing on the medulla, and softening, with or without the marks of extravasated blood. In some cases extravasation has been the only morbid change discovered. In two cases under the writer's care there were extravasations of blood in the spinal canal in the cervical and upper dorsal regions, and the same was observed in another case under the care of a colleague. In one of these there was very marked softening of the cord in the regions named. In these three cases death took place suddenly. Dr. Dickinson's theory of the origin of diabetes in lesions of the nervous system, represented by enlarged perivascular spaces, the sites of existent or pre-existent extravasations of blood with destruction of the surrounding nerve-tissue, is hardly tenable. The exploration of the sympathetic system has not been more satisfactory.

Rokitansky found (in 15 out of 30 cases) that the *liver* was enlarged, hyperæmic, and hard, of a dark-brown colour, with its acini imperfectly defined. The same conditions were present in the cases examined by the writer. When the disease has lasted a long time, the liver may be smaller than natural. The same would appear to hold good with regard to the cells themselves. Early in the disease, the cells, especially in the outer portions of the acini, are large, plump, and rounded, instead of angular, with large and distinct nuclei. They tend to assume a wine-red colour with solution of iodine, from the presence of unchanged glycogen. There are also sometimes found signs of active cell-growth at this early stage. Later the cells seem smaller, and as if undergoing pigmentary degeneration.

The condition of the *pancreas* in diabetes is highly interesting. In 13 out of Rokitansky's 30 cases, it was strikingly small, hard, and bloodless; and in many cases it has been found so shrunken and altered as to be hardly recognisable save by its connexions. Such was the case in one instance the writer has seen, and in all his other cases the pancreas has been abnormal, usually contracted here and there, hard and knotty. In one case, however, the organ was enlarged and more succulent than usual, probably the first stage of the mischief. The occurrence of so important pancreatic changes in about one-half the cases of diabetes would seem to indicate more than a casual connexion with the disease. What this connexion really is remains unascertained. Klebs has associated the changes with disease of the cœliac plexus. One result from the pancreatic mischief is inability to digest fat. This was seen in one of the cases referred to above. *See* Pancreas, Diseases of.

The *kidneys* Rokitansky found diseased in 20 instances, but the changes were not uniform. Usually they presented the ordinary indications of hyperæmia, being enlarged, dark red, and full of blood. Occasionally there were signs of more extensive mischief, the substance of the kidney as well as its vessels and epithelium being involved, and the organ harder than natural. Often fatty changes occur. In one case of the writer's amyloid changes had begun in the Malpighian bodies.

The *lungs* are frequently diseased: in only 7 of his cases did Rokitansky find them normal; Dr. Dickinson only twice out of 27 instances. The changes included all stages, from acute or chronic pneumonia, to the formation of numerous cavities, or even to gangrene. In one of the writer's cases the whole of the upper lobe of one lung was converted into a huge cavity filled with solid and semi-fluid detritus, having no gangrenous odour. There had been no expectoration, and no hæmorrhage, though vessels were exposed.

The *stomach* and *intestinal canal* present little beyond the ordinary signs of recurrent or chronic catarrh—thickening, mammillation, and slaty pigmentation; erosions and ulcerations may, however, occur.

Symptoms.—The following sketch comprehends the more characteristic clinical features of diabetes; but there are often important variations in individual cases, though a certain number of features are common to all: The patient, most likely a male between twenty and forty-five, when he comes before the physician has in all probability been suffering from the disease for some time; for it usually comes on insidiously. He may say that he has been in failing health for a varying period; that he has been very thirsty, and has passed much water, having to get up repeatedly for this purpose during the night. His appetite has been more than hearty; but his food seems to do him no good, for he has been constantly growing thinner, and he feels weak and ill. On closer examination it is found that he is daily passing as much perhaps as eight, ten, or more pints of urine, light in colour and of a peculiar sweetish odour, of a high specific gravity, perhaps 1040°, and containing an abundance of sugar. The skin is dry and harsh; the tongue red and glazed or slightly furred; the mouth dry and clammy; the lips, teeth, and gums are covered with scanty, sticky mucus; the breath is often sweetish, or it may be unpleasant from the state of the mouth; the bowels are confined; and the countenance wears an expression of weariness and fatigue.

From this point the malady may progress in one or other of two directions. Under judicious management the symptoms may ameliorate. Often the first indication of improvement is a copious perspiration; the thirst diminishes; less urine is passed; the appetite is not so ravenous; the sugar decreases in quantity; and with it the specific gravity is lessened. Emaciation ceases, and the patient begins to regain weight. This auspicious commencement may, with time and care, end in a more or less complete return to health. Unfortunately there is another side to the picture, for, notwithstanding all our efforts, the patient often goes from bad to worse. We fail to reduce the quantity of sugar beyond a certain point. The appetite gets more and more voracious, especially for starchy articles of food, to obtain which the patient will sometimes lie or steal, and yet there is often no feeling of satiety. Sometimes the appetite fails, and then emaciation goes on still more rapidly. All sexual power and feeling have long ago been lost, the testes sometimes undergoing almost complete atrophy. The harsh, dry, and itchy skin becomes the seat of boils, or even of carbuncles. Often the sight is injured by cloudiness of the refractive media, especially of the lens, or by retinitis and other morbid changes. All this time the temperature is low, perhaps sub-normal; but towards the later stages of the malady it often rises. Such a rise indicates the accession of a formidable complication which might almost be said to be the natural termination of diabetes. This superadded mischief is a peculiar insidious kind of pneumonia, resembling acute pneumonic phthisis, and giving rise to local signs resembling those characteristic of that malady. The progress of this lung-mischief is rapid; the fever increases; and often there is irrepressible diarrhœa, sometimes of fatty-looking matter. As the end approaches, the sugar usually disappears from the urine, which may become albuminous and scanty. There may even be some œdema of the extremities. The end often comes swiftly, and without warning, by acute pneumonia, or by what, for want of a better name, we call diabetic coma, or more slowly by gradual exhaustion. After the onset of pulmonary symptoms it is never very long delayed. Such may be said to be the ordinary course of a well-marked case of diabetes. There are cases slighter, where the history is different; but in both sets of cases there are certain symptoms, which demand further consideration than has just been given them.

The Urine.—The characteristic of the urine in diabetes is the presence in it of sugar in notable quantity, though this varies greatly in different cases. In the earliest and slightest forms of diabetes, small quantities of sugar may be passed now and again, as after a meal or the consumption of an unusual quantity of starchy or saccharine food; but the sugar may completely disappear in the interval, or may do so finally by the use of an animal diet. The sugar thus excreted is glucose of the kind called dextrose, from turning polarised light to the right, is readily soluble in water and alcohol, and easily ferments. When diabetic urine is allowed to stand in a warm place, fermentation soon sets in, gas being disengaged, and yeast deposited at the bottom of the vessel. The proportion of sugar to urine is usually from 8 to 12 per cent., but varies; the total quantity passed amounting to 20 or 25 ounces, or even more. Its presence in such proportion causes an increased specific gravity, though this is not invariably the case, inasmuch as it may vary from 1008 to 1060 or 1070. Along with the presence of sugar, we almost invariably find an increase in the quantity of the urine. But neither is this an invariable feature of diabetes, for sugar may exist with a normal quantity of urine, constituting the so-called *diabetes decipiens.* But in most cases there is a marked increase, the quantity passed amounting to eight, ten, or fifteen pints daily; and even the highest of these rates has been greatly exceeded. With an excessive amount of urine, its colour becomes lighter; sometimes it has a faint greenish tint, and when passed is quite clear. On standing there is no ordinary sediment, though, as already said, sporules of yeast may be deposited after a time. There is, on the whole, an excess—sometimes a large excess—of urea; and if the quantity of urine passed be small, deposits of uric acid or of the amorphous urates may appear. Very great inconvenience may arise in diabetic females, or even in males, by the arrest of saccharine urine about the external genitals, producing a raw or eczematous condition of the inside of the thighs and groins. The urine, being also almost invariably acid, is highly irritating to the raw and swollen parts. Enuresis is common, especially at night, and among diabetic children. Albumen makes its appearance sometimes in the progress of the disease, or in its later stages.

The Digestive Organs.—As the correlative of the unusual flow of urine we have also, as a marked and early symptom of diabetes, extreme thirst, a thirst, too, which cannot be satisfied, for apparently the more the patient drinks the greater is the thirst. This sensation is in some part due to the dry and clammy condition of the mouth, which it is difficult to relieve. Hunger, or even a voracious desire for food, is usually a prominent feature in diabetes, but is not invariably present, and in the later stages there may be complete loss of appetite, amounting to a loathing, especially for a restricted diet. It is often impossible to satisfy the intense craving for food, and should satiety be attained the sensation lasts but for a little time. The mouth is usually dry and parched, the saliva being scanty and tenacious. Often particles of food are retained about the teeth, and there putrefy, giving rise to unpleasant odours. The buccal fluid is almost always acid instead of alkaline, probably from the formation of lactic acid. The tongue is rarely perfectly natural. Seegen describes it as usually thickened and increased in volume, with fissures and glazed blood-red islands on its surface, which, however, may present a general coating. The teeth often fall out without pain, from the retraction of the gums, and are singularly liable to caries. Digestion is usually good, except during catarrh of the stomach, which is a rather frequent condition. Constipation is the rule in diabetes, often to a troublesome extent. This arises partly from the deficiency of water in the bowel; partly also from the small quantity of fæcal residue from an exclusively meat diet. Diarrhœa, on the other hand, is not uncommon, and rapidly diminishes the patient's strength.

General Symptoms.—Emaciation is an early and marked symptom of diabetes, but not invariably so, for diabetes often occurs and persists in stout persons, without removing the obesity. These are cases of the more tractable kind, the patients being usually somewhat advanced in life. Their complete cure is seldom effected, but they do not seem to suffer greatly from the malady. Though the emaciation is in great part due to the removal of fat, and in part to the abstraction of water from the tissues, there seems to be also an actual waste of muscular substance, especially in the advanced stages of the disease. With this emaciation are associated weakness, weariness, and disinclination to exertion. These are often among the earliest symptoms of the disease, and may occur long before wasting is noticed, but increase markedly towards the close of the malady. From various causes (one being, doubtless, weakening of the heart), œdema of the lower extremities may occur, with or without albuminuria. Gangrene of the extremities, of the senile kind, has been observed.

Respiratory Apparatus.—With regard to the respiratory organs, a peculiar apple- or hay-like odour of the breath is sometimes observed, probably arising from the production of acetone mixed with alcohol. But the most serious pulmonary symptoms are those of phthisis, resulting from a more or less chronic pneumonia. This mischief is usually indicated by a nightly rise in the temperature, but otherwise may remain for a time almost latent. It is most common in the young, and towards the end of the disease. The expectorated matters may contain sugar. Gangrene of the lung, or a form of necrosis of the lung-tissues, has been noticed. With this form of gangrene the sputum may be odourless.

Skin.—The skin is usually dry and scurfy, often extremely itchy; wounds inflicted by scratching heal with difficulty. Copious saccharine sweat is observed in a certain number of instances. There is a marked tendency to the formation of boils and carbuncles. Boils often occur early in the disease, and may give the clue to the existence of diabetes. Carbuncles occurring late in the disease may be the immediate cause of death.

Nervous System and Special Senses.—The sight is often affected in diabetes, most frequently by the formation of diabetic cataract. Operations in such cases do badly till the disease is cured, and are seldom tried, for the cataract occurs late in the disease, and advances rapidly. A form of retinitis not unlike that of albuminuria is sometimes found. Other forms of imperfect vision of uncertain origin occur in diabetes. They go by the general term of diabetic amblyopia.

Along with the physical, the mental powers fail, and the moral sentiments become blunted, which, to the friends of the patient, is not the least distressing feature of the malady.

Genital Organs.—Early in the history of the disease, all sexual appetite disappears, and sexual power soon fails in the male—but with improvement this may return. In the advanced stages amenorrhœa is not unusual amongst females.

Complications.—Several of the symptoms just described are regarded by some authorities as complications of diabetes rather than as belonging essentially to the disease. Such are especially diabetic cataract and amblyopia, boils and carbuncles, and the chronic pneumonia or phthisis in which diabetes so frequently ends.

Amongst the intercurrent diseases that are specially to be watched for and seriously regarded, one of the most important is albuminuria, the appearance of which may encourage a false prognosis, from the fall in specific gravity of the urine that attends it.

Diabetic Coma.—This is a not infrequent terminal symptom of diabetes. It is more liable to occur in the early stages of severe cases in young persons. It is especially noted after muscular exertion, and after the first adoption of an anti-diabetic diet. Constipation predisposes to its development. Cases of diabetic coma are divided into three groups. In the first group the attack begins with headache or epigastric pain and nausea, followed by a great feeling of anxiety, or by restlessness and perhaps delirium, after which a peculiar dyspnœa sets in. The dyspnœa affects both inspiration and expiration, and no physical cause can be found for it on examination of the chest, and there is usually no cyanosis. Comatose symptoms then come on, which gradually deepen. The pulse is much quickened, and the temperature is abnormal. The coma generally ends fatally within forty-eight hours, and only a few cases have been known to recover. The symptoms of the second group closely resemble those of renal uræmia. The dyspnœa is not so well marked as in the preceding form. The patient complains of general weakness, becomes drowsy, lapses into a state of coma with low temperature and small pulse, and soon dies. The third form exhibits all the symptoms of acute alcoholic intoxication. The patient does not show the same muscular weakness as is observed in the two preceding forms. He is attacked suddenly by great excitement, staggering gait, and drunken delirium. Gradually drowsiness and coma develop as in the other forms, and death ensues. In all these forms, and during and preceding the attack, a peculiar sweet smell, resembling chloroform, is perceived in the breath. The urine has a similar odour; and it gives the so-called 'acetone reaction' with perchloride of iron—that is, when a solution of perchloride of iron is added in excess a deep red port-wine colour is produced.

The pathology of diabetic coma has been much debated. Kussmaul believed that the symptoms were due to the presence of acetone in the blood; but it has been shown that other substances besides acetone give the peculiar reaction with perchloride of iron. The blood of diabetics has been often observed to contain excessive quantities of fat. Drs. Sanders and Hamilton described a case of diabetic coma, in which much fat was found in the blood, and numerous fat-emboli were seen in the pulmonary capillaries; and they suggested that fat-emboli in the lungs and brain were the cause of the symptoms. Similar cases have been described by others. Drs. Dreschfeld and Taylor, however, were unable to find fat-emboli in seven cases examined by them, although the blood was exceedingly rich in fat.

Diagnosis.—The diagnosis of diabetes depends on the discovery of sugar, in notable quantity, in the urine of the patient. But before the investigation for sugar is undertaken, there have usually been observed by the patient some of the early indications of diabetes, of which the following are the most frequent, though no one definite symptom invariably heralds the disease: (1) dryness of the mouth and thirst; (2) bodily weakness and gradual emaciation; (3) dryness of skin, with itching and a tendency to successive crops of boils; (4) urination in increased quantity, the urine being of a greenish-yellow tint, with the odour described; (5) defects of vision. Occasionally the attention of the patient is drawn to the state of his urine by the attraction it presents to ants, flies, and other insects; or by the formation of white spots of sugar on his dress and boots left by the urine on evaporation.

We must not forget that in true diabetes we find sugar in notable quantity. There are often present in the urine other reducing agents (such as uric acid and colouring matters), so that the amount of sugar detected must be such as to admit of no doubt whatever. Again, the presence of the sugar must be persistent, hence a single examination will not suffice for diagnosis unless sugar be found in large quantity. It may so happen that the patient when seen is not passing sugar, from the influence of restricted diet, or from some other cause, such as pneumonia or other feverish condition. It is then best to examine the urine passed an hour or two after a meal, or even to permit the use of starchy food for a day or two, so that the constitutional proclivities of the patient may be the better ascertained. To determine the existence of sugar is not enough: it is always necessary to determine the quantity passed, so as to obtain a clue to the intensity of the disease, and to judge of the effects of treatment.

Qualitative Testing for Sugar.—The presence of sugar in the urine may be detected in various ways. When saccharine urine is mixed with yeast and kept in a warm place, it speedily ferments, with production of alcohol and evolution of carbonic acid; and as no other substance is capable of undergoing this transformation, the occurrence of fermentation with yeast is certain proof of the presence of sugar. The signs of fermentation are evolution of carbonic acid and the lowering of the specific gravity. By the latter of these two signs considerably less than one per cent. of sugar can be detected in the urine. The method of carrying out this test is fully described under the head of quantitative testing.

Moore's or Heller's test.—When saccharine urine is boiled with liquor potassæ the sugar is decomposed, and a compound is formed, giving its colour, black or brown, to the fluid. A convenient test-tube is filled one-third full with the urine, and an equal quantity of liquor potassæ is added. The two should then be well mixed by shaking, and the heat of a spirit-lamp applied to the upper portion of the mixed fluids. If sugar be present this portion will gradually darken, the tint assumed varying in depth according to the quantity of sugar present. This test is very convenient, but it is liable to several objections, notably these:—(*a*) It is far from delicate, requiring as much as three parts in a thousand, or a grain and a half of sugar to the ounce, to afford any satisfactory indication. (*b*) It is practically useless for quantitative purposes, though the plan has been tried of comparing the colour produced with the colours of solutions containing known quantities of sugar, as is done in the Nessler process for substances producing ammonia and its allies. (*c*) It is liable to two notable fallacies. (1) High-coloured urine is always darkened in tint, sometimes blackened, by boiling with liquor potassæ. (2) Liquor potassæ very often contains lead, which is liable to be converted into black sulphide when boiled with caustic potash, if albumen or any organic matter be present in the urine. The former of these risks cannot well be obviated; the latter may, by first testing the purity of the liquor potassæ, and keeping it in green glass instead of white glass bottles.

Indigo-carmine test.—If a solution of indigo-carmine be rendered alkaline by carbonate of sodium, and boiled with a small quantity of grape-sugar, the indigo-blue becomes reduced to indigo-white, and causes the blue solution to assume a yellow colour. This test, originally introduced by Mulder, has been recommended by Dr. George Oliver, who makes use of it in the convenient form of test-papers. Two test-papers, one saturated with indigo-carmine, and the other with carbonate of sodium, are digested in a small quantity of water, the result being a clear blue solution. To this one drop of the suspected urine is added, and the mixtures boiled; if sugar be present the blue colour will successively give place to reddish-violet, different shades of red, and finally to a pale yellow tint. On standing, the solution reabsorbs oxygen from the air, and gradually returns to its original blue.

Picric acid test.—This test was introduced by Dr. George Johnson. The principle of the method depends on the power of grape-sugar to change a yellow solution of picric acid, in the presence of caustic potash, to a red solution of picramic acid—and the depth of the red colour varies with the amount of sugar present. Dr. Johnson has also applied this method for quantitative determination. The test is, however, less delicate than that of Fehling, to be presently described.

Trommer's test.—Equal volumes of the suspected urine and liquor potassæ are mixed together in a test-tube with a few drops of a 10 per cent. solution of sulphate of copper. Heat is then applied; and, if sugar be present, when the boiling-point is reached an orange-coloured precipitate of suboxide of copper is produced. This mode of applying the copper-test is, however, far inferior to the following.

Fehling's test or method.—This testing fluid may be procured ready-made, but the following is the formula for it, as slightly modified by Dr. Pavy, and fitted for daily use:—Five grains of sulphate of copper, ten grains of neutral tartrate of potassium, and two drachms of liquor potassæ. A more exact formula will be given farther on. The fluid thus formed is of an intense blue colour, clear and bright. When the test-fluid is to be used, a small quantity of it should first be raised to the boiling-point, because by prolonged keeping the tartaric acid undergoes change, a substance being formed from it which is capable of reducing copper, and might give rise to confusion. But if on boiling the test-fluid no copper is thrown down, the suspected urine should be added drop by drop, the mixed fluid being at the boiling-point. If sugar be present in quantity, it will throw down the copper in the form of a red or orange precipitate. The quantity of urine added must never exceed the bulk of the test-fluid, and the upper portion of the fluid should be heated, so as to contrast with the lower portion. Should suboxide of copper be thrown down when the test-fluid is boiled, the fluid must be filtered before adding the suspected urine, or, still better, a new fluid be prepared. To obviate as far as possible such inconveniences, the cupric and alkaline fluids should be kept in separate bottles until about to be used.

When the quantity of sugar in the urine is very small, as may occur in ordinary diabetes after long fasting or the use of a rigidly restricted diet, or during an access of fever, still more minute precautions must be taken. The most important of these is to use a great excess of the test. When the copper solution is added drop by drop to a healthy urine, at a boiling heat, the blue colour is immediately discharged, although not a particle of sugar be present, and the urine assumes a deep amber tint. The degree to which urines exercise this decolorising property over Fehling's test varies with their concentration. A dense urine (sugar free) will discharge the colour from nearly its own bulk of Fehling's standard solution; but even the most dilute urines have a considerable power this way. To avoid this fallacy, and secure an excess of the test, the most certain method is to heat the solution first, as already recommended, and to add the suspected urine afterwards—and never to add more, but always something less, than the bulk of the test-solution. The mixture is then again raised to the boiling-point. It then changes (if sugar be present) to an intense opaque yellowish-green, and slowly a bright yellow deposit subsides. If the urine contain less than half a grain per cent. the precipitation does not take place immediately, but occurs as the liquid cools—in five, ten, or twenty minutes—and the manner of the change is peculiar. First the mixture loses its transparency and passes from a clear olive-green to a milky opacity. This green milky appearance is quite characteristic of sugar. Some of the natural urinary ingredients have a certain power of reducing the oxide of copper to a state of suboxide, and of becoming thereby a source of fallacy in using this test for the detection of sugar. But this fallacy is easily avoided by not prolonging the ebullition. The fluid should simply be raised to the boiling-point, and then allowed to slowly cool. If such a proceeding fail to yield an indication of sugar, no amount of boiling will develop a trustworthy reaction. An increased delicacy can be imparted to this method by the following process, first suggested by Seegen. The urine is repeatedly filtered through animal charcoal until it is completely colourless. A little pure water is then passed through the filter, and to this water the test is applied in the usual way. An exceedingly minute trace of sugar (0·01 per cent.) can be detected by this procedure.

Quantitative Testing for Sugar.—*Fehling's volumetric method.*—This method, now in common use, is founded on the fact that the proportion in which sugar reduces copper is constant. One equivalent of grape-sugar decomposes exactly ten of sulphate of copper, or 180 parts by weight of grape-sugar decompose 1246·8 parts by weight of sulphate of copper. This being borne in mind, and a copper solution of known strength being used, it is easy to determine the quantity of sugar in any given specimen of urine. The quantities may be calculated according to the metric system, or by grains and minims. If we adopt the metric system, our fluid will consist of the following ingredients:—

Sulphate of Copper (crystals) 40 grammes.
Tartrate of Potassium (neutral) 160 grammes.
Liquor Sodæ (sp. gr. 1·12) 750 grammes.
Water to 1154·5 cubic centimetres.

These should be carefully mixed; or, what is better, the copper and alkaline solutions are made separately, so that five cubic centimetres of each, or ten of the mixed fluids, will exactly decompose ·05 gramme or 50 milligrammes of sugar.

According to the English system of measurement, Dr. Pavy's solution is the most convenient. It consists of sulphate of copper, 320 grains, dissolved in ten ounces of distilled water; and tartrate of potassium (neutral), 640 grains, with caustic potash 1280 grains, also dissolved in ten ounces of distilled water. These fluids may be kept separate or mixed. In mixing, the copper should be added to the alkaline solution, not *vice versâ*, to prevent the formation of any precipitate. One hundred minims of this mixed fluid are decomposed by half a grain of sugar. Only a minim measure and a porcelain capsule, or other vessel which will stand heat, are required for Dr. Pavy's solution in the procedure, which is as follows: Most specimens of diabetic urine, containing too much sugar for accurate testing, first require dilution with water; and the most convenient degree of dilution is when one-tenth of the fluid is urine. Next put ten cubic centimetres of the metric copper solution, or one hundred minims of Pavy's solution, carefully measured, in a small porcelain capsule. The fluid being deep blue is better for dilution, so as to diminish the intensity of tint. Of course this does not alter the quantity of copper present in it. The porcelain capsule with its contents is to be placed on an iron retort-stand, at such a level that the flame of a spirit-lamp will easily play on the capsule. Meanwhile a pipette, graduated from above downwards, either in minims or cubic centimetres, is filled up exactly to the 0 in the graduated scale with the diluted urine. When the solution of copper is boiling, the urine is added to it from the pipette, drop by drop, stirring carefully the while, until signs are shown of a decoloration of the cupric solution. The moment all the copper has been thrown down as suboxide, and all shade of blue or green has disappeared, the addition of the diluted urine is stopped, and the quantity already used read off on the graduated pipette. To ascertain the quantity of sugar in the urine is now a simple calculation. We know how much urine has been employed in reducing the 10 cubic centimetres, or the 100 minims, of the cupric fluid, but these measures represent exactly 50 milligrammes and half a grain of sugar respectively. The quantity contained in the diluted urine being hence deduced, multiply this by ten, to get the quantity contained in the urine as passed. Next multiply by the total quantity of urine passed in twenty-four hours, to ascertain the full amount of sugar passed in this period. In all such analyses the sample examined should be taken from the mixed urine passed during the whole twenty-four hours. That passed after prolonged fasting is the richest, that passed three or four hours after a meal the poorest, in sugar.

Roberts's fermentation method.—We have already noticed the fermentation method for demonstrating the existence of sugar in urine. Sir William Roberts has also devised from it a highly accurate quantitative process. It is as follows:—

Put about four ounces of the suspected urine into a clean eight- or twelve-ounce glass bottle. Introduce a piece of dry German yeast, about the size of a cob-nut, but divided into small pieces. Cork the bottle with a grooved cork to allow the escape of gas. Fill a companion bottle *quite full* with the urine. Cork quite tightly, and set the two side by side for twenty-four hours in a warm place—the mantelpiece will do. By the end of that time fermentation will probably have ceased, and the yeast fallen to the bottom. The specific gravity of the two specimens must now be carefully taken with an accurate urinometer, that of the unfermented bottle being taken as the standard. The fermented urine will have lost density from two causes: First, the sugar which gave the increased specific gravity has been destroyed; and, second, in its place have been formed alcohol, which is lighter than water, and carbonic acid, which has escaped. *Every degree of specific gravity thus lost represents a grain of sugar in the ounce of urine.* Thus, if there is a loss of twenty-five degrees of specific gravity, the urine would contain twenty-five grains of sugar in each ounce. Multiply this by the total number of ounces passed, to get the amount of sugar discharged *per diem.* This plan is especially useful for noting the quantity of sugar passed day by day, and can be easily undertaken by the patient or his friends.

Estimation by the polariscope.—A plan of estimating sugar employed a good deal abroad depends upon the power of diabetic sugar to turn the plane of polarisation to the right. The degree of rotation is in proportion to the quantity of sugar contained in the urine. The apparatus used commonly goes by the name of the Ventske-Soleil apparatus, from its inventors. It is best adapted for light-coloured urines. If the urine be deep in colour it requires to be diluted.

Prognosis, Course, and Terminations.—The prognosis of confirmed diabetes is ever unfavourable. Amelioration is common, but a perfect cure, save in exceptional cases, is rare. Diabetes coming on suddenly and from special causes, such as injury to the head, is more likely to do well than when more gradually developed. The younger the patient, the more sugar passed, the greater the emaciation and debility, the worse is the prognosis. Diabetes persistent with pure flesh diet is worse than if persistent only with a free starchy or saccharine diet. Loss of appetite and of digestive power, as indicated by the condition of the fæces, is of evil omen. When albumen appears in the urine in the course of diabetes, the specific gravity of the fluid diminishes, often giving rise to a false impression to the effect that, as the specific gravity has decreased, the diabetic state must be improved. The only true test of recovery is the power of consuming ordinary mixed food with impunity; but Seegen says that out of two hundred cases he had never seen this result. But by rigid or limited dieting, the patient may live, and even enjoy life, for many years. Heredity, directly or collaterally, adds to the darkness of the outlook. Cases resulting from injury to the brain or other parts of the nervous system are often the most hopeful with which we have to deal, though by no means always so.

The course of diabetes is on the whole chronic. Most frequently it develops gradually, though in some cases suddenly; and it generally lasts from six months to three or four years. In stout elderly persons it may exist much longer, especially with good digestion and a limited dietary. On the other hand, Sir William Roberts records a case which proved fatal, after a well-marked onset, in eight days—the shortest period known to the writer. Another case was fatal in three weeks, the patient being three years old. Some cases are recorded of death at still earlier periods, but these were most probably cases of long duration in an unnoticed shape suddenly developed into an aggravated form. A fatal termination of diabetes may be brought about, as already indicated, in various ways. One is by diabetic coma, not unlike the first stages of uræmia. In the advanced stages of diabetes, the strength being very low, comparatively slight causes may produce fatal effects.

Treatment.—Though we are ignorant on many points as regards diabetes, yet when we come to its treatment, we have these undoubted facts—that sugar cannot be formed out of nothing; and that the series of substances out of which it may be formed is limited. And though we cannot absolutely succeed in feeding the patient on substances which will not yield sugar, we can supply a nourishing diet furnishing sugar-forming materials in the scantiest proportion—an end best attained by a pure meat diet. But besides dietetic measures, other, though subsidiary, means may be taken to limit the formation of sugar by suitable hygienic and medicinal treatment. It is convenient to treat of these separately, though they should be employed in conjunction.

Dietetic treatment.—All authorities agree that meat should be the main constituent of the patient's food, and that starch, and cane and grape sugar, should be avoided, as well as the substances containing them. It is very important in constructing a diet scale to give the patient as much variety of form as possible, the basis remaining the same. As the diet of the patient is the main factor in his treatment, it is worth the practitioner's while to study the various changes and combinations of food which may be given with impunity. As regards vegetables, the rule is that all green vegetables, or the green parts of vegetables, may be eaten; for where chlorophyll is abundant, starch and sugar are commonly scanty; but this rule has important exceptions, which will readily occur to the reader. Thus the green parts of asparagus and celery may be used, whilst the white portion is highly saccharine. Globe artichokes may be used; Jerusalem artichokes are objectionable. Cabbage, endive, spinach, broccoli, Brussels sprouts, lettuce, spring onions, water-cress, mustard and garden cress, and celery may be used freely. Most fruits are forbidden, but nuts may be used if they can be digested. French beans may be used when quite green; when older the beans themselves must be removed. Haricot beans, peas, and all cereals; tapioca, sago, arrowroot, all forms of macaroni, potatoes, carrots, turnips, parsnips, and beetroot are in the forbidden list. Cheese, especially of the poorer kinds, may be used. Cream, butter, and other fatty articles may be used freely. To sweeten tea or coffee, gluside has been suggested; but both will soon be found more refreshing without any sweetness. Cocoa made from the nibs can be used. Small quantities of cold tea without milk or sugar, with slices of lemon in it, will often be found palatable, cleansing the mouth and relieving thirst. Rinsing the mouth with iced water will often give more relief than a hearty draught. Slowly sucking ice is a very good plan for relieving thirst. All sweet drinks are in the forbidden list, including most sherries and ports, though some of the former may be found nearly sugar-free. Nearly all brandies contain sugar. Light French and German wines contain little or no sugar. Gingerbeer and lemonade are very objectionable; so are champagne, sweet beer, cider, porter and stout, rum and gin. Whisky is probably the best form of spirit. The use of alcohol in these cases has been gravely questioned. Where alcohol has not been used before the onset of the disease, the patient is probably better without it; but it is quite clear that in many cases it may be taken in moderation with advantage.

There is difficulty in procuring a substitute for bread and potatoes. Three imperfect substitutes are employed—namely, gluten bread, bran bread, and almond bread. Gluten bread, as introduced by Bouchardat, consists of flour out of which nearly, but not quite, all the starch has been washed. It is tough, and patients tire of it; better forms of gluten bread may be easily obtained in London. This last is palatable and nearly starch-free, but does not keep well. Bran bread is now often made, in the form of biscuits or cakes; the bran should always be washed nearly free of flour. Bran bread is hardly admissible when there is a tendency to diarrhœa, but may be useful in constipation. Almond cakes were first introduced by Dr. Pavy. They are rather rich to be eaten with meat, but used by themselves or with wine are excellent. Almond flour may now be obtained from which much of the oil has been expressed.

We pass over Dr. Donkin's skim-milk treatment of diabetes with the remark that in the hands of Dr. Donkin and some others the method has been successful; in the hands of many eminent physicians, both at home and abroad, it has done unmitigated harm. Probably the explanation of any successful cases may be found in the fact, that in certain conditions of diabetes, milk-sugar, as well as certain other substances, does not give rise to grape-sugar. If milk is to be used, buttermilk or sour milk will be best. The treatment by sugar or glycerine is self-condemned.

Hygienic treatment.—In this the first and most important point is regular exercise, especially riding or walking, short of fatigue. Bouchardat has strongly advocated gymnastic exercises. These would be useful in moderation, especially in bad weather. Nothing is more grateful or beneficial to the skin after such exercise, or even without it, than a warm bath, temp. 80° to 90°, with a little common washing soda in it. In all cases the avoidance of wet and cold is important. Flannels, frequently changed, should be worn; and it is always safer to change the clothes after the slightest exposure to damp. Little may suffice to give rise to a fatal pneumonia.

Medicinal treatment.—This must be considered as subsidiary to dieting, but there are many cases where undoubted benefit results from drugs. Of those which have been found of real value, the foremost is opium. Yet there is no unanimity of opinion as to the mode in which opium acts, and its apparent effects are most discordant—in some cases reducing both sugar and urine without sleepiness, in others speedily giving rise to drowsiness and even apparently to coma. The varied susceptibility of different patients to this drug is very striking. Some will take 20 or even 50 or 60 grains a day with no apparent physiological effect beyond slight contraction of the pupil; others again cannot endure even a few grains. The writer's experience is decidedly in favour of opium. Morphine answers well in some cases. Codeine has been strongly recommended by Dr. Pavy as being the influential ingredient in the raw opium. He begins with doses of half a grain. Next to opium come alkalis, and especially some alkaline waters. Alkalis themselves may be given in various forms—as cream of tartar to relieve thirst, as citrate or bicarbonate of potassium, or, if there is a tendency to gastro-intestinal catarrh, as liquor potassæ, with or without a bitter. The waters in most repute in diabetes are those of Carlsbad, Vichy, Vals, Bethesda, and Contrexeville. An annual visit to Carlsbad, with the rigid system of regimen and dietary carried out under the resident physicians, often suffices, with due care, to keep the patient fairly well for many years.

Lactic acid has been strongly advocated by Cantani. His results seem good, but he also makes use of a most rigid dietary. Pepsin and rennet have been used, but without real advantage.

Of secondary remedial agents, the three most important are strychnine, iron, and cod-liver oil; these favour nutrition, and the cod-liver oil seems to improve the temperature somewhat. Laxatives, not purgatives, should be used for the troublesome costiveness. Mineral waters, castor oil, or alkaline purgatives suit best. Phosphorus in combination with iron as hypophosphite, taken in pills, has proved useful.

Management of a Case of Diabetes.—By way of recapitulation we may say a few words here on the management of a case of diabetes. When a case comes under the care of the practitioner he must first ascertain the general state of the patient as a basis for future comparison. The patient's weight must be carefully taken, and the state of his bowels noted. The quantity and characters of urine passed should be noted daily for a short time, the patient still consuming ordinary diet, unless there be some urgent reason to the contrary. After a day or two the restricted diet should be gradually commenced, sugar and potatoes being first cut off. Next the bread should go, being first of all cut down and used toasted hard or torrefied, and this should merge into the use of bran cakes or gluten bread. Above all things, the patient must not be disgusted with his food, for this favours the secret consumption of forbidden dainties. Week by week the weight should be taken; day by day the sugar estimated, as may easily be done by Roberts's method, and the whole arranged on a card so as to be seen at a glance. Warm baths, exercise, and the other adjuvants must be assiduously employed; and as soon as the effects of the limited diet are clearly marked, opium may be tried, if required. If well borne it should be used determinedly, and pushed to its physiological effects, as indicated by the contracted pupil. If the patient is seen daily, his diet should be regulated each day; if only at intervals, certain available changes should be indicated. When convalescence begins, and the urine has for some time been free from sugar, the diet may be gradually relaxed, beginning with substances containing little starch or sugar, gradually extending to bread in small quantity; potatoes should come last; sugar itself never. When, with every care, restriction of diet effects no diminution of sugar, or, if that be limited, emaciation and weakness rapidly go on, it will be a question whether it may not be best, as it often is, to return to a practically unrestricted diet.

Alexander Silver.

DIAGNOSIS of Disease.—*See* Disease, Diagnosis of.

DIAPHORESIS (*διά*, through; and *φορέω*, I convey).—The act of perspiring. The term is more generally applied to perspiration artificially induced.

DIAPHORETICS (*διά*, through; and *φορέω*, I convey).

Definition. — Remedies which increase the secretion of sweat. When the increase is so great as to cause the perspiration to stand in beads upon the surface, they are usually termed *sudorifics*.

Enumeration.—The principal diaphoretic measures are—The Vapour Bath, Turkish Bath, and Wet Pack; Warm Drinks; Warm Clothing; Jaborandi, Pilocarpine; preparations of Antimony; Ipecacuanha; Opium and Morphine with their preparations; Sarsaparilla, Guaiacum, Serpentary, Sassafras, Senega, Mezereon, Camphor; Sulphur; Ammonia and its Carbonate, Acetate, and

Citrate; Alcohol; Ethers (especially Nitrous Ether); and Chloroform.

Action.—The secretion of sweat usually consists of two parts, namely, a free supply of blood to the sweat-glands, and the abstraction from it of the materials for sweat by the cells of the gland. These two processes sometimes occur independently of each other. In fevers the supply of blood to the glands is abundant, but they do not secrete; and a similar condition is observed in belladonna-poisoning. Belladonna and atropine possess the power of paralysing the secreting nerves of the sweat-glands, just as they do those of the salivary glands, and thus the skin remains dry, although the cutaneous vessels are much dilated. In collapse the cutaneous glands secrete a cold sweat profusely, although the supply of blood to them is deficient.

The secreting cells appear to be under the influence of nerves, by exciting which secretion occurs. The centres for the secreting nerves of the sweat-glands appear to be situated in the spinal cord, and in the medulla oblongata. The fibres seem to run in the same path as the vaso-motor nerves. The secretory nerves of the sweat-glands may be excited directly by stimulation of the nervous trunks in which they run; and the sweat-centres may also be reflexly excited by irritation of various sensory nerves. Certain substances, such as nicotine and carbonic acid, seem to stimulate the sweat-centres; whilst other drugs, such as pilocarpine, appear to act upon the peripheral terminations of the secretory nerves in the sweat-glands themselves. Several remedies, at the same time that they excite secretion, likewise increase the flow of blood through the skin, rendering it redder, warmer, and more vascular. Others, again, excite the secretion at the same time that they diminish the cutaneous circulation. Diaphoretics have therefore been divided into two classes, the former kind being termed *stimulant*, and the latter *sedative* diaphoretics. The exact mode in which each drug already enumerated produces diaphoresis has not yet been ascertained; but antimony, ipecacuanha, and jaborandi are classed as sedative diaphoretics, and all the others as stimulating ones. The supply of blood and the secretion are both increased by the application of warmth, by the ingestion of warm fluids, and by the action of jaborandi.

Uses.—Diaphoretics are employed to increase the flow of blood to the surface, and possibly to aid the elimination of excrementitious products in internal congestion, such as catarrh of the respiratory passages or digestive tract, and in febrile conditions generally. In fevers, the cutaneous circulation is generally active, and the so-called sedative diaphoretics are then most useful. Diaphoretics are also used to increase the elimination of water by the skin, and thus lessen the accumulation of fluid in dropsy, or to relieve other excreting organs, such as the kidneys in albuminuria and diabetes insipidus, or the intestines in diarrhœa. In these cases stimulant diaphoretics are indicated. T. Lauder Brunton.

DIAPHRAGM, Diseases of the. The diaphragm is an important part of the respiratory apparatus, in relation to the movements of breathing, and by no means receives the attention from a pathological and clinical point of view which it deserves. Only a brief outline of its affections can be given within the limits of the present article; and for practical purposes they may be conveniently discussed according to the following arrangement:—

1. Physical Interference with the Diaphragm, and Displacement.

2. Functional Disorders. (*a*) **Paralysis.** (*b*) **Spasm.**

3. Organic Lesions. (*a*) **Injury, Perforation,** and **Rupture—Diaphragmatic Hernia.** (*b*) **Inflammation, acute** or **chronic.** (*c*) **Muscular Rheumatism.** (*d*) **Atrophy** and **Degeneration.** (*e*) **Morbid Formations.**

1. Physical Interference with the Diaphragm, and Displacement.—The diaphragm is frequently interfered with by morbid conditions within the chest or abdomen, which impede its movements, displace it more or less, either upwards or downwards, or render it tense and stretched. The entire structure may be thus affected, or only a portion of it, such as one lateral half or its central part. The chief thoracic conditions by which the diaphragm may be thus affected are pleuritic effusion, empyema, or pneumothorax, emphysema of the lungs, abundant pericardial effusion, enlargements of the heart, and tumours within the chest. Chronic contracting affections of the lung and pleura tend to draw it upwards, by a process of suction. Pleuritic adhesions, considered independently, have rather a depressing influence than otherwise (Walshe). The principal abdominal conditions which may raise the diaphragm are a distended stomach, tympanites, ascites, peritonitis, pregnancy, large fæcal accumulations, and tumours or enlarged organs which attain considerable dimensions, especially ovarian, hepatic, splenic, or renal tumours. It sometimes happens that the diaphragm is interfered with both from its thoracic and its abdominal aspects. Tight lacing may materially embarrass and alter the position of this structure.

Symptoms.—The symptoms induced by this mechanical interference are readily explained by its effects. A sense of uneasiness and discomfort is often experienced around the lower part of the chest, amounting sometimes to considerable tension or tightness.

There is not any actual pain, but in some instances, where the diaphragm is much pushed down, the patient complains of a painful sensation referred to the ensiform cartilage, as if the attachment of the diaphragm at this point were being severely dragged upon. The act of respiration is more or less impeded, and this often seems to be the cause of the discomfort experienced. A sensation frequently complained of by patients is that they cannot take a full breath. Respiration may be much hurried, or oppressed and laboured; and not uncommonly the normal relation between the thoracic and abdominal movements is markedly altered, as observed on inspection and palpation, and the diaphragm may so act as to draw in the lower part of the chest-walls in inspiration. Occasionally a kind of spasmodic cough seems to be excited by the tension of the diaphragm produced by certain conditions. The act of coughing is also frequently rendered more or less difficult and ineffectual.

The actual position of the different parts of the diaphragm in a particular case can only be determined by carefully noting the physical signs afforded by the structures in contact with it, on its thoracic and abdominal aspects respectively.

2. Functional Disorders.—The affections of the diaphragm included within this group are (*a*) **Paralysis**; and (*b*) **Spasm.** It will be understood that in the cases now under consideration there is no structural change in the diaphragm itself.

a. **Paralysis.**—The diaphragm is completely paralysed when the spinal cord is destroyed at the origin of the phrenic nerve, whether as the result of injury or disease. If one or both phrenic nerves be cut across, destroyed by disease, or even severely compressed, the same effect will be produced, either one lateral half or the whole of the diaphragm being paralysed, according as one or both nerves are involved. This structure may also be implicated in diphtheritic paralysis; lead-palsy; and hysteria. Diaphragmatic paralysis has also been attributed to cold. *See* Phrenic Nerve, Diseases of.

Symptoms.—Where paralysis of the whole diaphragm is suddenly produced, death speedily ensues from the grave impediment to the respiratory function resulting therefrom. If it is brought about gradually, or if only part of the structure is involved, the effects are seen in more or less interference with this function, and with the acts in which respiration is concerned. Thus there will be a subjective sensation of a want of power to breathe; while the respiratory movements may be hurried and shallow. It has been noted, however, that, when the patient is at rest, breathing is often quite easy, but any exertion causes it at once to become frequent, and brings the extraordinary muscles of respiration into play. Physical examination shows that, if a deep inspiration be taken, the epigastrium and hypochondria sink in instead of protruding, while during expiration these regions bulge out again. If only one half of the diaphragm is affected, this abnormal movement is unilateral. Coughing and sneezing cannot be performed efficiently, and sputa cannot be easily expelled; while the abdominal acts for which a tense diaphragm is required, such as defæcation or vomiting, are also ineffectual or impracticable. A peculiar dysphonia has been described, in which the voice loses its power as the day advances, becoming at last a mere cracked whisper. The lower parts of the lungs tend to be more or less collapsed and congested; and if bronchitis sets in, the patient is in grave danger.

b. **Spasm.**—The diaphragm may be the seat either of clonic or tonic spasm or cramp. The disorder may depend upon disease of the nerve-centre at the origin of the phrenic nerves; irritation of these nerves in their course; direct excitation of the diaphragm; or reflex causes. Tonic spasm is most strikingly observed in cases of tetanus; of poisoning by strychnine; or of hydrophobia. A form of asthmatic attack has also been attributed to this condition of the diaphragm; and it may result from immoderate laughter.

Symptoms.—The symptoms will vary in different cases. Tonic contraction of the diaphragm gives rise to severe pain, and a sense of constriction in the corresponding region, which may come on in paroxysms; clonic spasms also originate painful sensations after a time, which may become very considerable. Hiccough is probably due mainly to a clonic spasm of the diaphragm (*see* Hiccough). If this structure should become rigidly fixed, respiration is gravely interfered with, and the patient soon presents the phenomena of apnœa, which will end fatally if the spasm is not relieved. In the form of asthma supposed to be due to diaphragmatic spasm, expiration is very difficult and greatly prolonged, inspiration being short and abrupt; the lungs are distended; great distress is felt; and there may be signs of impending death from suffocation. A spasmodic cough may be due to clonic spasm of the diaphragm.

3. Organic Lesions.—These may be briefly considered in the order in which they were enumerated at the commencement of this article.

a. **Injury, Perforation, and Rupture — Diaphragmatic Hernia.** — The diaphragm may be perforated, lacerated, or ruptured in connexion with various forms of injury, such as crushing accidents, fractured ribs, penetrating wounds, or gunshot injuries. Should the patient recover, a permanent opening may be left. Rupture of the diaphragm may also occur from violent strain, as of persistent retching, or during parturition; and from the effort to conceal or suppress the cries of pain in parturition. In medical practice perforation of this structure may be met with as a congenital condition; as the result of the bursting of some fluid-collection through it, such as an empyema, pulmonary abscess, a sub-diaphragmatic, hepatic, renal, or other abscess, or a hydatid-cyst; or from its destruction in the progress of some organic lesion, such as malignant disease, an aneurysm, or a chronic gastric ulcer. It may occasionally occur independently of these causes, owing to the yielding of a weak portion of the diaphragm, especially between the attachment to the ensiform cartilage and the seventh rib. Congenital perforation is rare, but a considerable portion of the diaphragm may be thus deficient. The size and other characters of the perforation differ much in different cases. If it is produced by the opening through the diaphragm of a fluid-accumulation, this fluid escapes from the abdominal into the thoracic cavity, or *vice versâ*, the latter being exceptional; in other instances portions of the thoracic or abdominal organs pass through the perforation, constituting forms of *diaphragmatic hernia*. The writer had the opportunity of observing a remarkable instance in which the entire stomach had passed through an opening in the diaphragm into the cavity of the chest. In a case reported by Dr. Little, of Dublin, the diaphragm presented an almost circular opening, well-defined, sharp, with somewhat thick edges, and through this opening passed a hernia consisting of peritoneum containing some omentum, and about fifteen inches of the transverse and descending colon. The stomach and colon most frequently pass through the diaphragm. In rare instances the small intestines, spleen, or other structure form part of the hernia.

Symptoms.—To recognise clinically a perforation or rupture of the diaphragm is generally no easy matter. In cases of sudden and extensive rupture, there will probably be grave collapse and speedy death, and the patient may present marked risus sardonicus. Often there are no symptoms referable to the diaphragm, though there may be signs indicating that its functions are more or less impeded. The occurrence of sudden perforation may be known from the previous existence of some condition likely to cause this event, such as empyema, or an abdominal abscess; the supervention of acute pain, accompanied with indications of shock or collapse, and the disappearance or modification of the signs of the original morbid condition; followed by the development of phenomena revealing that fluid has passed through the diaphragm, and accumulated in the thoracic or abdominal cavity, as the case may be, or that some secondary affection has been set up as the result of the perforation, such as peritonitis or pleurisy. A fluid collection may, however, penetrate the diaphragm without giving rise to any very evident disturbance. When an organ passes through this structure, the symptoms present, if any, are more likely to be associated with this organ than with the diaphragm, and physical examination may possibly detect the displacement. In the case of hernia of the stomach already referred to, the chief symptom was urgent vomiting, which occurred immediately after taking any food or drink.

b. **Inflammation—Diaphragmitis.**—The serous covering of the diaphragm, either on its thoracic or abdominal aspect, is not uncommonly involved in cases of acute pleurisy or peritonitis respectively, and the inflammatory process may penetrate its structure. It may also be involved by extension from pericarditis. Inflammation of the substance of the diaphragm may further arise from injury, direct irritation, pyæmia, or without any evident cause. The anatomical conditions observed are increased vascularity and sometimes ecchymosis; the formation of lymph upon its surfaces, or exudation into its substance; softening and degeneration of its muscular tissue or central tendon; or, in rare instances, suppuration, an abscess forming in the substance of the diaphragm, or pus collecting under one or other of its serous coverings. Ulceration and gangrene have been noticed in exceptional instances. Chronic inflammation of the diaphragm may occur, leading to a fibroid change in its muscular portions, either by extension from neighbouring structures, or as the result of chronic local irritation.

Symptoms.—The symptoms of acute inflammation of the diaphragm are generally very obscure and ill-defined. The condition may be indicated by severe pain in the region of this structure, of burning and constrictive character, obviously increased by breathing, so that the respiration becomes instinctively thoracic, as well as hurried and shallow; and also much aggravated by coughing, defæcation, or any other act which disturbs the diaphragm, as well as by movements of the trunk, and pressure over the epigastrium. Sighing, hiccough, painful dysphagia, risus sardonicus, and violent delirium are other symptoms described. The movements of respiration will indicate more or less complete paralysis of the diaphragm. The patient will probably be much distressed. More or less pyrexia will be observed. If an abscess should form, this might burst either into the chest or abdomen, and thus lead to secondary pleurisy or peritonitis. The inflammation might also spread to the pericardium. Chronic inflammation and its consequences may possibly be suspected from a want of free movement in the diaphragm, associated with conditions likely to originate this change; but it could scarcely be recognised with any certainty.

c. **Muscular Rheumatism.**—The diaphragm may be involved in this complaint, whatever its nature may be; probably it is attended with structural changes in the tissues. The affection is characterised by pain referred to the diaphragm, which may be very acute when it is in any way brought into play. So long as it is kept at rest, there may be no discomfort, but deep breathing causes considerable pain, so that the respiration is carried on in a shallow manner, and may be entirely thoracic. Such acts as coughing or defæcation cause much pain and a sense of aching.

d. **Atrophy and Degeneration.**—The diaphragm may be involved in the course of progressive muscular atrophy; it may also be atrophied from causes which produce general wasting; or undergo senile atrophy and degeneration; or be similarly affected from local causes, such as interference with its blood-supply from vascular degeneration, want of action, or after chronic inflammation. Fatty and fibroid degeneration are the chief forms met with. Brawny induration has been noticed in scurvy. These conditions tend to give rise to more or less evident interference with the functions of the diaphragm, which in extreme cases would amount to their total cessation, diaphragmatic breathing being rendered impossible, the symptoms being then the same as when the diaphragm is paralysed. In cases of progressive muscular atrophy the fatal termination may arise from this cause. There would not be any pain, but uncomfortable sensations might arise from the impeded respiration.

e. **Morbid Formations.** — The diaphragm is occasionally the seat of malignant disease, being usually involved by extension from some neighbouring structure. Syphilitic and other non-malignant solid growths have in rare instances been found in it. Parasitic formations may also occur in it—namely, hydatids, cysticercus, and trichina spiralis. Tubercle is occasionally found in the diaphragm. Possibly malignant disease might be indicated by signs of impeded diaphragmatic movements, with localised pain, accompanying indications of cancer in other parts. The implication of the diaphragm in trichinosis may also be recognised in some instances by severe pains, spasmodic contractions, and serious interference with diaphragmatic respiration. In most cases, however, the presence of any morbid growth in connexion with the diaphragm cannot be diagnosed during life, and is only discovered at the *post-mortem* examination.

Treatment.—But little can be done in most cases in the way of direct treatment in connexion with affections of the diaphragm. One of the most obvious indications is to get rid, if possible, of any condition which is mechanically displacing it, or impeding its movements, and preventing it from performing its functions. In the next place, any disease of which the condition of the diaphragm is but a part must receive due attention, such as progressive muscular atrophy, centric nervous disease, diphtheritic paralysis, lead-poisoning, hysteria, or trichinosis. Collapse or shock due to a sudden diaphragmatic lesion must be treated on the usual principles. Painful affections might be relieved by local applications of dry heat, fomentations, support by a bandage, or anodynes; and if acute inflammation is suspected, a few leeches might be applied. Paralysis or spasm of the diaphragm may call for the employment of electrical treatment, applied through the phrenic nerve; and various remedies are found useful in hiccough. *See* Phrenic Nerve, Diseases of; and Hiccough.

Frederick T. Roberts.

DIAPHRAGMATIC HERNIA. — *See* Diaphragm, Diseases of the.

DIAPHRAGMITIS. — Inflammation of the diaphragm. *See* Diaphragm, Diseases of the.

DIARRHŒA (διαῤῥέω, I flow away).—Synon.: *Defluxio*; *Alvi Fluxus*; Purging; Fr. *Cours de Ventre*; *Dévoiement*; Ger. *Der Durchfall*; *Bauchfluss*; *Durchlauf*.

Definition.—A frequent and profuse discharge of loose or of fluid alvine evacuations, without tenesmus, mainly due to increased peristalsis of the large intestine.

Ætiology.—The causes *predisposing* to diarrhœa are individual peculiarity; childhood—especially the period of first dentition; the climacteric period; and hereditary or acquired weakness of the digestive organs.—The *exciting* causes may be thus classified: 1. *Direct irritation of the intestines* by: (*a*) *Food* in excess, or of improper quality—for example, salted meat, shell-fish, sour unripe fruit and vegetables, diseased, decomposed, or imperfectly masticated; the products of faulty digestion prematurely passing the pylorus; imperfectly elaborated and fermenting chyme; impure water, such as that containing from 3 to 10 grains of putrescent animal matter per gallon (Parkes); or imperfectly fermented malt liquors. Acute diarrhœa, especially in hand-fed infants, is very frequently caused by fermentation of milk either previous to or after ingestion—the irritant effect being due either to undigested casein, to the products of acid or alkaline fermentation, or to the formation of poisonous ptomaines or the presence of bacteria. (*b*) *Purgative medicines and irritant poisons.* (*c*) *Bile*, excessive or acrid. (*d*) *Fæces*, retained. (*e*) *Entozoa*—lumbrici, tæniæ, trichinæ, and *entophyta*—mycosis enteralis (Buhl and others). (*f*) The contents of a *ruptured abscess* or *hydatid-cyst.* (*g*) *Intestinal lesion*—such as tubercular or other ulceration.

2. *Defective hygiene.*—Diarrhœa may arise from the dwelling being damp, cold, dark, and unventilated; or from foul emanations from decaying organic, especially animal matter, sewage, or fæcal collections. 3. *Chills, climatic variations, &c.* Diarrhœa has been attributed to insufficient clothing; sudden exposure to cold and damp; chills, as from wet feet, and damp bed or clothing; and rapid variations of temperature, such as hot days and cold nights. 4. *Nervous disturbances*, for example, depressing emotions—fright, grief; neuralgia, hepatalgia (Trousseau), dentition, and other causes of reflex disorder. 5. *Defective absorption with augmented peristalsis* of the small intestines, so that the food is passed unaltered—*lienteric diarrhœa.* 6. *Symptomatic* in various morbid states, for instance, in passive congestion of the portal vein from disease of the liver, heart, or lungs; peritonitis, especially puerperal; organic disease of the intestines—ulceration (simple, stercoral, typhoid, tubercular, cancerous), lardaceous degeneration, enteritis, acute or chronic; cholera; typhoid fever; dysentery; occasionally in pyæmia, measles, scarlatina, confluent small-pox, malaria, gout, Bright's disease (its later stages), and in anæmia and exhaustion, as from over-lactation, phthisis, cancer, Addison's disease, Hodgkin's disease, exophthalmic goître, leukæmia, and other affections.

Frequently diarrhœa arises from the combined action of several exciting causes, as when the disease is epidemic during summer and autumn. Pollution of air, water, and food by foul emanations from organic matter decomposing in very hot weather, overcrowding, food (and especially fruit) in a state of incipient decay, excessive heat, and chills, may then collectively determine the result. In children the exalted irritability of the nervous system during dentition predisposes to diarrhœa from slight determining causes. In several forms of diarrhœa fermentation of the intestinal contents plays an important part—*e.g.* in infantile and summer diarrhœa.

Description and Varieties.—Diarrhœa may be broadly divided into the *acute* or occasional, and the *chronic* forms; and the numerous clinical and pathological peculiarities of different cases are conveniently grouped into typical varieties. The general effects, varying according to the intensity and duration of the flux, are mainly these:—Emaciation, and, in children, also arrest of growth—the weight either diminishing or ceasing to be progressive; anæmia, indicating defective hæmatosis; desiccation of the tissues from the rapid draining of serum from the blood—hence the thirst, and the very concentrated, acid, and even albuminous urine observed when there is a copious watery outflow from the bowels, as in choleraic and similar forms of diarrhœa.

It will be expedient to describe briefly the principal forms of diarrhœa.

1. **Irritative Diarrhœa.** — Synon.: *Diarrhœa crapulosa* (Cullen).—Simple flux from direct irritation of the intestines is the most common variety of diarrhœa. The evacuations, usually preceded by severe griping pains, are at first feculent and usually fetid and sour, then watery. In children (especially hand-fed) they are often like pale clay or putty, or they contain dense masses of undigested casein before being loose; after evacuation they frequently become greenish, like chopped spinach, from contact with very concentrated acid urine converting the brown colouring matter of the bile into green biliverdin; or they are dark green when passed, and may be so acrid as to excoriate the anus, the genitals, the inner parts of the thighs, and even the heels. Fever is usually absent.

Diarrhœa from irritation is frequently a preliminary stage of the inflammatory, dysenteric and choleraic varieties.

2. **Inflammatory Diarrhœa.**—Synon.: *Diarrhœa serosa.* — When the causes of simple irritation excite inflammation of the mucous membrane of the bowels, fever sets in, and the diarrhœa increases. Usually the evacuations become more serous, and contain shreds of fibrin or mucus or pus. Before the attack passes off, the large bowel is apt to be the main seat of inflammation; then the motions are scanty, frequent, more mucous or glairy, contain streaks of blood, and are passed with severe straining. At the same time the skin is hot and dry.

3. **Choleriform Diarrhœa.** — Synon.: Choleraic diarrhœa; Thermic diarrhœa. This form prevails mostly in hot weather. The onset, indicated by vomiting and purging, is usually sudden. At first the vomited matters are mucous and bile-tinted, and the dejections are feculent—both quickly, however, becoming more and more abundant, watery, and colourless. The copious and incessant outflow of serum may in a short time, and especially in children, induce a striking resemblance to the symptoms of Asiatic cholera—a drawn, sunken, and cyanotic appearance, loss of temperature, scanty secretion of urine, insatiable thirst, and cramps. Even in extreme cases, however, the fluids from the stomach and bowels are rarely free from bile, and are not so like rice-water as in true cholera. The collapsed algid condition, as a rule, rapidly gives place to recovery in previously healthy adults, while it is apt to become fatal in delicate children, children prematurely weaned, the debilitated, and the aged. Rarely, the cold stage being outlived, the patient becomes hot, and passes into a state of stupor, with either bilious vomiting or purging and tympanites—the typhoid stage. In children death is almost invariable if the cold stage exceeds twenty-four hours.

4. **Nervous Diarrhœa.**—The peristaltic movements, and the activity of the glands, of the alimentary canal, are often increased by causes operating through the nervous system. Diarrhœa from mental, and especially emotional, perturbation, is the most common example. Even a chronic looseness may be maintained by debility of the nervous system, induced by worry and anxiety. Exalted innervation of the bowels may be natural, a proneness to diarrhœa from slight exciting causes having always existed; or acquired, when, for instance, a flux once established is apt to be maintained. The unstable nervous system of the periods of rapid development and of the climacteric change predisposes to it. It is often an important factor in chronic diarrhœa. The intestinal nerve-centres may become so sensitive (as in delicate children) that every meal, however small, may induce an immediate call to stool, the motions being liquid or pultaceous, and pale, but otherwise healthy. The peristaltic movements may be even so increased as to hurry the food through the stomach and bowels, so that it appears unchanged in the stools. Time is not allowed for digestion or absorption to be even begun. This form has been termed *Diarrhœa lienterica*, and is most frequent in children before the period of the second dentition. The increased tonicity of the muscular fibres of the alimentary tract may have resulted from previous inflammation of the mucous surface, or is the propagation upwards of some irritation (ulcer, inflammation, &c.) of the mucous membrane of the rectum; or it arises from the products of imperfect primary digestion entering the duodenum. Indigestion is the usual cause in adults. The appetite is, as a rule, voracious; and debility may become extreme. In painful or difficult dentition, diarrhœa arises from irritation of the nerves of the stomach and bowels; digestion is arrested; and the contents of the alimentary canal become acid from fermentation, and are ejected by vomiting and purging.

5. **Vicarious Diarrhœa.** — Embarrassment or suppression of the functions of the skin, kidneys, or lungs may lead to the bowels performing additional excretory work. The flux thus set up is salutary, because compensatory. Diarrhœa from chills (suppressed perspiration) is a common instance, while that from renal and pulmonary causes is less frequently observed, and may be misconstrued by the practitioner. Inasmuch as diarrhœa usually diminishes the quantity of urine, even sometimes to the verge of suppression, the reverse of this clinical fact may be easily overlooked or misinterpreted. Even when forewarned, the observer may at times —especially when the urine is free from albumen — find it difficult to determine whether the diarrhœa is a cause or an effect of imperfect renal elimination: a distinction having all-important bearings on the treatment. The uræmic and eliminatory character of it may be easily decided when the kidneys are known to be diseased; not so, however, when the only thing ascertainable is scanty—may be albuminous—urine, or total suppression of urine in an elderly patient. In such a case there may or may not be organic disease of the kidneys, and still the diarrhœa may be uræmic, inasmuch as it may depend on 'renal inadequacy.' Diarrhœa from pulmonary embarrassment generally affords relief to breathing and cough. The chronic looseness of some gouty patients is also eliminatory: when it is checked, gout is apt to advance, and the health to suffer.

6. **Diarrhœa from Mechanical Congestion.** — Draining of serum into the bowels is a common result of overloading of the portal vein from an impediment to the flow of blood, either in the vein itself, the vena cava, or the right side of the heart.

7. **Chronic Diarrhœa.** — Synon.: Cachectic diarrhœa.—Chronic diarrhœa is frequently, if not generally, unconnected with intestinal lesions. It may be maintained by chronic catarrh of the intestines, or by an exhausted and impoverished state of the system, as in inanition, either from insufficiency of food or from enfeebled digestion, or in chronic wasting diseases, such as syphilis, malaria, or scurvy. The flux increasing, the debility on which it depends thereby perpetuates itself, and this vicious circle tends more and more to destroy life by anæmia and exhaustion, and even after apparent recovery the diarrhœa has a strong disposition to relapse. These clinical features of chronic diarrhœa are well illustrated by the malady which, from the paleness of the stools, is commonly known in India as 'White Flux'—a result of deterioration of health by climate and malaria (*see* Psilosis). When accompanied by fever and night-sweats, chronic diarrhœa is nearly always due to tuberculisation.

Diagnosis.—The different forms of diarrhœa may be readily distinguished from each other by a careful consideration of the causes and symptoms. The diseases most apt to be mistaken for diarrhœa are epidemic cholera, dysentery, and mucous irritation of the bowels from retention of fæces.

(*a*) *Cholera*, in its less definite forms, may resemble bilious diarrhœa and choleraic diarrhœa. The probability in favour of it may be determined by the absence of ordinary causes of diarrhœa, the paleness and watery character of the stools, tormina being slight or absent, the suppression of urine, and the early exhaustion. The presence of bile in the stools is always in favour of diarrhœa. Vomiting is more frequent in cholera; when it occurs in diarrhœa the vomited matter usually contains bile and undigested food, while in cholera it is a colourless fluid.

(*b*) *Dysentery* is usually characterised by fever, tormina, and tenesmus, and frequent scanty muco-sanguinolent evacuations. Sometimes, however, in the early stage, the motions are copious, watery, and feculent, as in ordinary diarrhœa; but the presence of tormina and tenesmus, and tenderness in the regions of the cæcum and sigmoid flexure, indicate the dysenteric nature of the disease. Chronic diarrhœa may be distinguished from chronic dysentery by the absence of a history of acute dysentery, and of mucus and tenesmus, and by the less frequent discharge of blood in the evacuations.

(*c*) *Mucous irritation of the bowels* from retention of fæces may induce a condition resembling diarrhœa—frequent, thin, muco-feculent evacuations, which are, however, shown, on inquiry, to be somewhat scanty, and voided with straining. *See* FÆCES, RETENTION OF.

TREATMENT.—(*a*) *Diet and Hygiene.*—In *acute* or *occasional* attacks of diarrhœa, everything should be taken in small quantity, and tepid or cold, never hot. Farinacea—arrowroot, sago, rice, tapioca, flour, and the like—are useful, and may be taken in milk, or in chicken or mutton broth, or weak beef-tea. Animal broths—and especially beef-tea—when concentrated, or in large quantity, are apt to aggravate diarrhœa. Demulcent drinks—white of egg in water or milk, rice or barley or arrowroot water; and astringent liquids—infusion of dried whortleberries or roasted acorns, red light wines—may be given. Brandy is often of service, and may be given in an aromatic water or with the farinacea. Lime-water with milk is in many cases of much value.

Rest in bed secures a uniform warmth of skin, and favours the cessation of diarrhœa.

In children, errors of feeding should be corrected. Lumps of casein in the motions may be prevented by reducing the quantity of milk, or by adding thin arrowroot or barley-water, with or without lime-water or bicarbonate of sodium, to the milk; and by regulating the time between meals, providing a wet nurse, or substituting the milk of the goat or ass for that of the cow. In infantile diarrhœa the milk should be previously boiled and diluted—one part in two or three of barley-water—and given regularly every hour in small quantities (two or three teaspoonfuls). The feeding-bottle, when not in use, should be kept in a weak solution of permanganate of potassium. Sometimes, however, milk in any form must be given up, when barley-water or thin rice-water, sweetened by saccharin or milk-sugar, may be substituted. The abdomen should be protected by a flannel bandage, and the feet and legs by warm clothing. *See* INFANTS, Diseases of; and DENTITION, Disorders of.

Inasmuch as in *chronic diarrhœa* the flux is perpetuated by the debility and anæmia which it induces, and by the activity of intestinal digestion, it has become a leading principle of treatment to prescribe food rich in materials for the construction of the blood and the tissues, and almost wholly disposed of by the stomach. Hence the happy results frequently observed from a diet exclusively animal, either raw or lightly cooked, the digestion of which may be aided by hydrochloric acid, alone or with pepsin. Individual peculiarity may be gratified, and variety obtained from the use of mutton, veal, chicken, pigeon, and game. Beef, the tough parts of veal, and pork are, as a rule, to be avoided. Milk and farinacea are gradually permitted during the progress towards recovery, but the period during which they should be interdicted may require to be very prolonged—even months. The treatment with *raw meat*, strongly advocated by Trousseau and Niemeyer, has been successfully applied to nearly every variety of chronic diarrhœa, but especially to that obstinate form occurring from the time of weaning to the close of the first dentition. The meat may be pounded into a pulp or finely minced; then mixed with salt, sugar, fruit jelly, or conserve of roses; or diffused through clear gravy soup, or chocolate made with water or wine. Or the juice may be extracted from it by pressure. Notwithstanding the prohibition of other food, it is best to begin with a small quantity, and to increase it gradually. The only drink allowable is water containing white of egg. Trousseau found opium in small doses, chalk, and bismuth, at and between meals, to assist this regimen. When a restricted animal diet cannot be digested, causes loathing, or aggravates the flux, other varieties of food may be added, and the feeding should be as generous and varied as possible, and adapted to the digestion of the individual. Articles of diet appearing undigested in the motions should be avoided. Low and damp situations should be exchanged for dry and open ones. Warm clothing, flannel next the skin, and flannel waist-belts should be worn. Chronic diarrhœa (lienteric and chronic tropical diarrhœa) has also been successfully treated by a strict milk diet and rest; and by rest along with massage.[1]

(*b*) *Medicinal Treatment.*—The kind and degree of interference required should first be decided in each case of diarrhœa. A routine prescription of astringents is much to be deprecated. When the flux is moderate and salutary—for example, removing undigested or indigestible materials or irritating secretions, relieving an engorged portal vein, or supplementing a suppressed secretion—it may be left uncontrolled by medicine, or may be encouraged by laxatives, such as castor oil, rhubarb, or a saline aperient, combined with a mild sedative, such as henbane or opium. As a rule, the treatment of diarrhœa should begin by removing irritating substances from the alimentary canal by laxatives, guarded by small doses of opium; and astringents, such as chalk-mixture with kino, catechu, hæmatoxylum, and opium, should be held in reserve. The laxative may increase the flux, which, however, soon subsides. Trousseau advocated the use of salines—sodii sulphas, soda tartarata, magnesii sulphas—in progressively decreasing doses, dissolved in a small bulk of water, in the morning, fasting, while others prefer castor oil, or rhubarb. Castor oil is by far the most useful remedy for children, as well as for adults. For the former it should be emulsified in gum and syrup, for the latter in yolk of egg; and as occasion requires it may be combined with a small opiate, for example, compound tincture of camphor, or the wine or tincture of opium, in proper doses.

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[1] Eccles, *Practitioner*, Dec. 1890 and Jan. 1891.

In *choleriform* or *summer diarrhœa*, the best results are obtained from castor oil guarded by a small dose of laudanum at the commencement, and repeated if the disease is severe; while astringents and opiates alone are withheld until the bowels are relieved of offensive materials, as in the later stages, the stools being copious and watery, griping and distension of the abdomen absent, and the tongue clean. Vomiting should be encouraged by copious draughts of warm water, and, if need be, by emetics of mustard or ipecacuanha. In children, when the motions are colourless, profuse, and incessant, it is best to give hydrargyrum cum cretâ in small doses every hour or two, and a very small enema of starch, containing plumbi acetas or cupri sulphas, with laudanum, which may be repeated if necessary. Remedies which are believed to arrest abnormal intestinal fermentation (such as naphthaline, calomel in small repeated doses, perchloride of mercury, potassio-mercuric iodide, carbolic acid, resorcin, salol, salicylate of sodium) have lately been employed with success in infantile and summer diarrhœa. Dr. Luff has obtained the most gratifying results from potassio-mercuric iodide, preferring the following formula: ℞ Liquoris hydrargyri perchloridi ♏xij.; potassii iodidi gr. ¾; chloral hydratis gr. j.; aquæ ad ʒj.; to be given every four hours to infants up to six months, and the dose to be doubled for children of more than one year old.[1] In the cold stage there have been recommended mustard baths (for twelve or fifteen minutes, several times a day); emetics (ipecacuanha 2 to 3 grains twice or three times in twenty-four hours); diffusible stimulants (ether in syrup every hour or half-hour). In the stage of reaction, saline aperients or calomel in small doses may be given; white of egg in water as a drink throughout; and, vomiting having ceased, and diarrhœa being established, bismuth, chalk or lime-water.

In *nervous diarrhœa* the first indication is to allay reflex excitability by the bromides; or, these failing, by opium. When diarrhœa is excited by food, the dose should be given shortly before meals. In *lienteric diarrhœa* arsenic is invaluable. Mal-digestion should be met by hydrochloric acid, bismuth with alkalis, or other appropriate remedies, according to the indications. Occasional doses of castor oil — alone, or with bismuth or small doses of opium or henbane—are useful in clearing away fermentescible matters, which are apt to maintain an irritable state of the bowels. Astringents should only be prescribed after the failure of these or similar measures.

In *vicarious diarrhœa* the skin should be made to act freely by warm baths, or hot air or vapour baths. In renal inadequacy counter-irritation across the loins, digitalis, and nitrate of potassium may be likewise indicated. The diarrhœa should not be arrested or even checked unless it be profuse and exhausting, especially after restoring or augmenting the action of the skin and the kidneys; it is sometimes advisable to nurse and encourage it.

Diarrhœa from passive congestion of the portal vein is to be met by treating the cause, for example, disease of the heart, by digitalis, iron, and other remedies.

The flux of *chronic diarrhœa* (lienteric and the chronic tropical diarrhœa known as sprue or psilosis) cannot, as a rule, be stopped altogether by astringents only—the evacuations while thus retained may decompose, and induce flatulence and colic, or fever. The general health should be restored and anæmia removed; the secretions will then generally improve and the diarrhœa subside. Tonics—iron, arsenic, quinine, strychnine—may be aided by astringents —mineral acids, opium, bismuth, chalk, or hæmatoxylum. The best preparations of iron are iron-alum —3 to 5 grains, and liquor ferri pernitratis—10 to 40 minims. Ipecacuanha and taraxacum are useful when the skin and liver are inactive: from 1 to 3 grains of powdered ipecacuanha may be given night and morning. Podophyllum—2 or 3 minims of a solution of 1 grain in 1 drachm of rectified spirit three or four times a day—is indicated when the motions are watery, pale or high-coloured, and passed with severe cutting pains. Saline purgatives in the early morning have been recommended—2 drachms of sulphate of sodium, sulphate of magnesium, or soda tartarata on the first day; then 1 drachm for fourteen days, dissolved in a small bulk of water, with avoidance of fluids after the dose. Lately Mr. Begg has reported successful results in the treatment of chronic tropical diarrhœa by santonin (the yellow crystals) gr. v., well mixed in a teaspoonful of olive oil, given in the early morning or at bedtime for six days.[1] The profuse sweating and colliquative diarrhœa of hectic is best met by hæmatoxylum and diluted sulphuric acid, or opium with astringent mineral salts—nitrate of silver, sulphate of copper, or acetate of lead—given by the mouth or rectum.

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[1] *Lancet*, Dec. 20, 1890.

Suppressed secretions, particular cachexiæ, disturbed innervation, congestion of the portal vein, and organic diseases of the intestines, form special indications for treatment when diarrhœa is present.

George Oliver.

DIATHESIS (διατίθημι, I dispose).—A morbid constitution, predisposing to the development of a particular disease. *See* Constitution, with which, in a somewhat more limited sense, this term is synonymous.

DIATHETIC DISEASES.—Constitutional diseases. *See* Constitutional Diseases.

DICROTISM (δίς, double; and κρότος, a stroke) is a term applied to the second great wave of the pulse. This dicrotic wave, or dicrotism, is due to a second expansion of the artery which occurs during the diastole of the ventricle. The *pulsus bis feriens* of old authors was a pulse in which a second beat became perceptible to the finger; an occurrence observed occasionally as an antecedent of hæmorrhage, and also in the course of fevers. The second beat perceived by the finger is not always the true dicrotic wave, but may in some cases be an exaggerated tidal wave. This is the wave perceived in the high arterial tension sometimes antecedent to hæmorrhage. Dicrotism is favoured by a low state of arterial tension, by elasticity of the arterial coats, and by quick and strong ventricular contractions. It is central in its origin, and is a secondary wave of pressure produced in the blood-column by the elastic recoil of the aorta after its distension by the blood injected at each ventricular systole. The recoil of the aorta causes the wave to spring towards the periphery from the closed aortic valves as a *point d'appui*. *See* Pulse.

B. Walter Foster.

DIET.—Definition.—The term 'diet' as here employed may be understood to express the regulation of food to the requirements of health and the treatment of disease.

General Principles.—In order to sustain life, a diet must consist of a proper apportionment of the following alimentary principles:—

1. Nitrogenous principles.
2. Non-nitrogenous principles (fats, carbohydrates, &c.)
3. Inorganic materials (saline matters and water).

Whilst these principles hold different relative positions of value, the absence or deficiency of either group will render a diet unfit for the support of life. Milk, the product provided by Nature as the sole article of sustenance during the early period of the life of mammals, may be regarded as furnishing us with a typical dietetic representative of all these principles. The egg also holds a like position, and, as all the parts of the young animal are evolved from it, must needs comprise all the materials for the development and growth of the body.

The required principles are contained in food derived from both the animal and vegetable kingdoms, and the diet may be drawn from either; but, looking to man's general inclination and the conformation of his digestive apparatus, it may be assumed that a mixed diet is that which is designed in the plan of Nature for his subsistence, and it is that upon which he attains the highest state of physical development and intellectual vigour.

Animal food, being identical in composition with the body to be nourished by it, is in a state to be more easily appropriated than vegetable food. It also appeases hunger more thoroughly and satisfies longer: in other words, it gives, as general experience will confirm, a feeling of greater stay to the stomach. Animal food possesses stimulant properties which have sufficed in certain instances, as after starvation, and in those accustomed to a vegetable diet, to produce a state allied to intoxication. This stimulating effect is further illustrated by looking at the relative character of animal and vegetable feeders. Liebig says that it is essentially their food which makes carnivorous animals in general bolder and more combative than the herbivora which are their prey. He then relates that a bear kept at the Anatomical Museum of Giessen showed a quiet gentle nature as long as it was fed upon bread, but a few days' feeding on meat made it vicious and dangerous.

The standard diet framed by Moleschott has been accepted as furnishing a model of what may be considered the requisite proportion of alimentary principles for maintaining health in a person of average stature under exposure to a temperate climate, and the performance of a moderate amount of muscular work. It runs as follows:—

Alimentary substances in a dry state required daily.

Dry Food	In ounces avoir.
Albuminous matter . .	4·587
Fatty matter . . .	2·964
Carbohydrates . . .	14·250
Salts	1·058
	22·859

This, it will be seen, furnishes a supply of about 23 ounces of dry solid matter, of which one-fifth is nitrogenous. If we reckon that ordinary food contains about 50 per cent. of water, then 23 ounces will correspond to 46 ounces of solid food in the condition in which it is consumed. To complete the alimentary ingesta, a further quantity of from 50 ounces to 80 ounces of water may be assumed to be required to be taken daily under some form or other.

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[1] *Practitioner*, Jan. 1891.

For a life of inactivity, it must be stated that a much smaller amount of food will suffice. The diet, for instance, which is ordinarily supplied to the patients of Guy's Hospital, and which suffices to satisfy and properly sustain them, only contains about 30 ounces of solid food, equivalent to about 17 ounces of water-free material.

It has been mentioned that there are reasons for regarding a mixed diet of animal and vegetable food as best adapted to our nature, and it may probably be considered that the most suitable admixture contains about one-fourth or rather more of animal food.

Looked at from the following point of view, it will be seen that an admixture of animal and vegetable food more economically supplies what is wanted than either kind taken alone, unless the adjustment should be made with the proper apportionment of fat as a representative of a non-nitrogenous article. It is estimated that for a man of medium stature, and performing a moderate amount of work, about 300 grains of nitrogen and 4,800 grains of carbon are required to be introduced daily into the system with the food, to compensate for the outgoing of these elements that occurs. Now this is yielded, as nearly as possible, in the case of both elements, by 2 lbs. of bread and $\frac{3}{4}$ lb. of meat—that is, 44 ounces of solid food, of which about one-fourth consists of animal matter. If the lean of meat only were consumed, rather over 6 lbs. would be needed to furnish the requisite amount of carbon, and there would be a very large surplus of unutilisable nitrogen; whilst if bread only were taken, the amount necessary to supply the requisite quantity of nitrogen would be rather more than 4 lbs., and this contains nearly double the amount of carbon wanted.

In order to preserve health it is necessary that a portion of the food consumed should be in the fresh state, and this applies to both animal and vegetable food. There may be no lack of quantity, and yet disease and death may be induced by inattention to this fact. Affections of the scorbutic class are produced, which can only be checked and removed by the supply of fresh food or the juice of some kind of succulent vegetable or fruit. The efficacy of lemon and lime juice, for instance, is well known in the prevention and cure of scurvy.

Climate influences the demand for food, and instinct leads to the adaptation of diet to the requirements that exist. Not only is there a correspondence between the amount of food required and the inclination for taking it, but the nature of the food selected in different countries varies and stands in harmony with that which is most in conformity with what is needed. The dwellers in the arctic regions, besides consuming a large quantity of food, partake of that kind which abounds in the most efficient form of heat-generating material—namely, oleaginous matter. In the tropics, on the other hand, it is upon vegetable products, largely charged with principles belonging to the carbohydrate group, that the native inhabitants mainly subsist.

Labour necessitates a supply of food in proportion to the amount of work done. The employer finds that the appetite of a workman may be taken as a measure of capacity for work—in other words, that a falling off of the appetite means a diminished capacity for the performance of labour.

Until recently it was considered, in accordance with the teaching of Liebig, that muscular and nervous action resulted from an oxidation of muscular and nervous tissue, and that according to the amount of action occurring, so was there created a demand for the supply of nitrogenous alimentary principles to replace the oxidised material. It is now held, however, that the non-nitrogenous elements of food contribute, as well as the nitrogenous, to the production of muscular and nervous force. Fick and Wislicenus undertook a known amount of work upon a non-nitrogenous diet, and proved that the oxidation of their muscular tissue, as measured by the amount of nitrogen voided with the urine, sufficed only for the production of a small proportion of the force expended in the accomplishment of the work performed. The muscles, in reality, appear to stand in the position of instruments for effecting the conversion of the chemical energy evolved by the oxidation of combustible matter into working power. Fats and carbohydrates can furnish the combustible matter required, and, under ordinary circumstances, probably do largely, if not chiefly, supply it. Nitrogenous matter can do so likewise, but it has to undergo a preparatory metamorphosis for effecting the separation of nitrogen in a suitable form for elimination. It must be said, however, that experience shows that hard work is best performed under a liberal supply of nitrogen-containing food. The explanation of this probably is that it leads to a better-nourished condition of the muscles and of the body generally. Under the use, for instance, of animal food, which is characterised by its richness in nitrogenous matter, the muscles are observed to be firmer and richer in solid constituents than under subsistence upon vegetable food.

Persons who lead a sedentary and indoor

life naturally require less food than those engaged in active work, and less should be consumed by them to prevent the system becoming clogged with effete products, which act perniciously in various ways upon the body. The food should also be largely constituted of non-nitrogenous principles, as these tax the excretory organs less than the nitrogenous.

The diet of *infants* is a branch of dietetics the importance of which can scarcely be overrated. The proper food during the first period of infancy is that which has been provided by Nature for the young of mammals—namely, milk. Up to about the eighth month the infant is designed to be sustained solely by its parent's milk. The teeth, which ordinarily begin to show themselves about this time, indicate that some solid matter should now be consumed, and one of the farinaceous products will be the most suitable with which to commence. Bread, baked flour, plain biscuit, or one of the numerous kinds of nursery biscuits that are made, may be employed for a time as a supplement to the former food. At about the tenth month the mother, who ought previously to have commenced lessening her own supply, should now cease it altogether. As the child advances through its second year, and the teeth become more developed, meat, preceded for awhile by gravy, may be given. If the mother cannot suckle her child, and if a wet nurse, whose supply stands next best to that of the mother, cannot be provided, the milk of one of the lower animals should be obtained, and that of the cow gives the nearest approach to what is wanted. Cow's milk, however, is richer in all its solid constituent principles than woman's, and the addition of a solution of sugar or—what is more in conformity with the natural supply—sugar of milk (lactose), in the proportion of an ounce to three-quarters of a pint of water, is needed to bring the two into closer approximation. The milk of the goat is even richer in solid constituents than that of the cow, and therefore stands somewhat further removed from that of the human subject. If, however, it is not adapted for infants, it is highly useful for improving the condition of badly nourished children, and is sometimes employed for this purpose.

Therapeutical Applications.—The application of the principles of dietetics may be successfully brought into use in the treatment of corpulency and thinness. A diet rich in nitrogenous matter, conjoined with exercise, promotes the growth of muscle, but the fat undergoes no increase. The conditions most conducive to an increased accumulation of fat are a diet rich in either fat or carbohydrates (provided the requisite amount of nitrogenous matter be present for affording what is wanted for the nutritive operations of life), exposure to a warm atmosphere, and inactive habits. A supply of fat in a direct manner leads to an increased deposition of fat in the system, but the carbohydrates require in the first place to undergo assimilative change before they can be applied in the same direction.

The details of the dietary to be prescribed where the aim is to produce increased stoutness and an improved condition of the body, should comprise such articles as fat meats, butter, cream, milk, cocoa, chocolate, bread, potatoes, farinaceous and flour puddings, oatmeal porridge, sugar and sweets, sweet wines, porter, stout, and ales.

The converse mode of dieting is necessary for reducing stoutness. Mr. Banting, by his noted system of dieting, reduced his weight from 14 st. 6 lbs. to 11 st. 2 lbs. in about a year. Besides altering, however, the character of his food, he limited the quantity in a manner that must have contributed an important share towards producing the effect observed — not more than twenty-two to twenty-six ounces of solid food (corresponding with eleven to thirteen ounces of water-free material) being consumed, according to his statement, in the twenty-four hours.

As a guide to the corpulent, it may be said that the fat of meat, butter, cream, sugar and sweets, pastry, puddings, farinaceous articles—as rice, sago, tapioca, &c., potatoes, carrots, parsnips, beetroot, sweet ales, porter, stout, port wine, and all sweet wines, should be avoided, or only very sparingly consumed. Wheaten bread should only be partaken of moderately, and brown bread is to some extent better than white. The gluten biscuits which are prepared for the diabetic may, on account of their comparative freedom from starch, be advantageously used as a substitute for bread in the treatment of obesity. The articles that may be taken to the extent of satisfying a natural appetite are lean meat, poultry, game, eggs, green vegetables, succulent fruits, light wines, dry sherry, and spirits. Milk should only be taken sparingly.

Holding the position that food does in relation to the operations of life, the art of dietetics not only bears on the maintenance of health, but is capable of being turned to advantageous account as a therapeutic agency; and it is not too much to say that success in the treatment of disease is oftentimes dependent upon a display of judicious management in regard to food.

In the therapeutic application of dietetics the maxim should be held in view that, whilst the particular requirements are secured, there should otherwise be no greater deviation from what is natural than the special circumstances of the case demand.

The quantity of food consumed may require to be regulated as well as its nature. The quantity administered at a time should stand in relation to the power of digesting it; and to properly compensate for a diminished capacity for taking quantity there should be a corresponding increase in the frequency of administration. 'Little and often' is the maxim to be followed upon many occasions, and much will sometimes depend upon the strictness with which it is acted up to; for, apart from harmonising with what is wanted, upon the principle that has just been referred to, it meets the defective aptitude that exists in sickness for sustaining any lengthened duration of abstinence from food.

In febrile, acute inflammatory, and other conditions where there is a failure of digestive power, the food administered should be such as not to tax the stomach, and should therefore consist of liquid materials. Solid matter by remaining undigested—and solids of an animal nature are particularly likely to do so —would act as a source of irritation in the stomach, and only serve to aggravate the condition of the patient. The articles under such circumstances to be selected from are beef-tea, mutton-, veal-, or chicken-broth, whey, calf's-foot and other kinds of jelly, arrowroot and such-like farinaceous articles, barley water, rice mucilage, gum water, fruit jelly, and the juice of fruits, as of lemons, oranges, &c., made into drinks. Where a little latitude is allowable, the employment of milk and of eggs in a fluid form may be sanctioned. As circumstances permit, an advance may be made to solid substances which do not throw much work on the stomach, as rice, sago, tapioca, bread and custard puddings, and stale bread or toast sopped. Next may be allowed fish, beginning with whiting. As power becomes restored, calves' feet, chicken, game, and butcher's meat—mutton to begin with—may be permitted to follow.

In cases of ordinary dyspepsia the aim of the physician should be rather directed to raising, by appropriate treatment, the digestive capacity to the level of digesting light but ordinary food, than to reducing the food to an adjustment with a low standard of digestive power. Of butcher's meat, mutton is almost invariably found to be the most suitable; chicken and game are allowable, also white fish (boiled or broiled), particularly whiting, sole, flounder, and plaice. Stale bread, dry toast, plain biscuits, floury potatoes, rice, and the various farinaceous articles form the kind of food derived from the vegetable kingdom to be selected. Green and other succulent vegetables, it is found, are more apt to create flatulence than other kinds of food, and articles belonging to the cabbage tribe are particularly to be regarded as obnoxious to those who have a tendency to this form of derangement.

Much depends in cases of weak digestion upon the state in which the food reaches the stomach. Thorough mastication affords great assistance to the performance of digestion; and when the teeth are bad, the food should be finely minced, or otherwise minutely divided, before being eaten. Regularity in the periods of taking food tends to promote the orderly working of the digestive organs. An interval of more than four or five hours' duration between the meals is to be avoided, as it acts perniciously in several ways. By inducing an exhausted state of the system it diminishes the energy of the digestive organs, and whilst having this effect it at the same time calls for the periodical exercise of increased energy, on account of the larger amount of food which must be taken at each meal to compensate for the length of time that is allowed to elapse between them.

In cases of ulcer of the stomach, acute gastric catarrh, and vomiting, the food must be selected from that which is nutritious and which at the same time taxes least the digestive powers. Milk—and this is often better borne after being boiled—milk and water, or milk and soda-water, will frequently be found to be tolerated when other articles excite irritation and are returned. Sometimes the milk may be advantageously mixed with isinglass, arrowroot, ground rice, or biscuit powder.

In dysentery and other forms of ulcerative disease of the intestine, scrupulous attention must be paid to diet. The food should consist of articles which are known to exert the least stimulant and irritant action on the mucous membrane and muscular coat of the alimentary canal, and those which best meet the demand in question are such as milk, isinglass, and the various farinaceous products, amongst which rice is pre-eminently valuable. Next to these come eggs, white fish, white-fleshed poultry, fresh game, and fresh meat. Salted and dried meats are highly objectionable, and fruits and succulent vegetables, with the exception of a floury potato, should be strictly shunned. *See* PEPTONISED FOOD.

The development of gout is known to be favoured by the consumption of a highly nitrogenised diet, especially if conjoined with sedentary habits. With those who have already experienced symptoms of the disease, and those also who have grounds for apprehending its invasion, it is important that an excess of nitrogenous food should be avoided. The diet should be simple, in order that the temptation may be avoided of eating too much, and should at the same time be adjusted to the mode of life. The principle to observe is that the higher the degree of inactivity the greater ought to be the preponderance of food derived from the vegetable kingdom.

Even of more importance than what is eaten is what is drunk, where the question of gout is concerned; and observation shows that it is not distilled spirits, but the stronger wines and malt liquors, which favour the production of the disorder. Nothing is more potent than port wine in leading to the production of gout, and a few years' liberal indulgence in it has often been known to be instrumental in bringing on the disease where no family predisposition had existed. Dry sherry and the light wines, as claret, hock, &c., may be drunk, certainly in moderation, with comparatively little or no fear of inducing the disease, although any kind of wine appears capable of sometimes acting as the exciting cause of a paroxysm where the gouty disposition is already established. Stout, porter, and the stronger ales, especially those that have become hard from age, rank next to port wine in their power of predisposing to gout. As regards the light bitter beers, which are so extensively used at the present time, the same must be said of them as of the light wines, viz. that with little, if any, disposition to induce the disease, they nevertheless appear capable of sometimes exciting its manifestation in a gouty subject. A pure spirit, as whisky, hollands, or brandy, diluted with water, often forms the only kind of alcoholic drink that is found to agree with those who are suffering from gout.

In Bright's disease with threatening uræmic poisoning it is a point of consideration to diminish as far as practicable the amount of excretory matter to be eliminated by the kidneys. The fats and carbohydrates throw no work upon the kidneys. Their products of destruction escape through another channel. Nitrogenous matters, on the other hand, undergo metamorphosis in the system, and yield nitrogen-containing compounds—chiefly urea—to escape by the kidneys. In this way the kidneys become taxed by nitrogenous food, and, to lessen the work demanded of them, reason suggests that the diet should preponderate in food derived from the vegetable kingdom.

In diabetes mellitus there is a want of assimilative power over the saccharine and starchy principles of food. Whilst these principles become utilised and lost sight of when ingested by a healthy person, in the system of the diabetic they fail to become consumed, but pass off under the form of sugar in the urine, giving rise to severity of symptoms in proportion to the amount of sugar escaping. Much may be done towards subduing the symptoms of the disease by a properly arranged dietetic scheme, and the principle upon which it requires to be framed is the exclusion, as far as practicable, both from what is eaten and what is drunk, of articles containing saccharine or starchy matters.

Observation has shown that the reaction of the urine is susceptible of being influenced by the character of the food. The effect of animal food is to increase the acidity of the secretion, whilst that of vegetable food is to diminish it, and even, it may be, to produce alkalinity. Hence, on persons affected with the lithic-acid diathesis, benefit is conferred by a plan of diet in which animal food is limited, and succulent vegetables and fruits, with the light wines, as claret, hock, &c., are freely supplied. On the other hand, with the phosphatic diathesis, the converse principle of action should be adopted.

F. W. Pavy.

DIGESTION, Disorders of.—The function of digestion is of a physico-chemical nature, being compounded of certain muscular acts, and of certain processes exercised by the digestive fluids on the ingesta, which are thereby converted into a fluid and diffusible state.

Any interference with the due performance of the several components of the function will lead to indigestion; and though it may for convenience be desirable to consider these disturbances separately, it must be remembered that the occurrence of one condition is apt to be quickly associated with another, and hence the forms of dyspepsia as they usually present themselves are of a complex nature, however simple the primary fault may have been. It appears to the writer to be very undesirable to restrict the application of the term *indigestion* or its synonym *dyspepsia* to the perverted actions of any one part of the alimentary system, such as the stomach, or to any one special morbid state, such as gastric or intestinal catarrh; but rather that it should include all departures from normal function which any part of the digestive tract may present. Nor is it possible to consider irregularities of digestion only from the point of view of the organs immediately concerned. Complicated as our organism is, disturbances of other functions will speedily make themselves felt in the one under consideration; and failures in the absorption of the digested food, or in its subsequent metabolic changes and elimination, will tell back sooner or later on that process which is, strictly speaking, limited to its preparation.

Causes of Dyspepsia.—Dyspepsia may be immediately traced to (1) *the food*; (2) *disturbances of the so-called mechanical processes*—namely, the muscular acts, solution, &c.; (3) *deficiencies in the chemical changes* exercised by the digestive secretions; or (4) *imperfect absorption* of digested products. It is to be understood that the three last-mentioned groups of causes which bring about indigestion are determined by certain gross or minute abnormal changes in the structural tissues of the organs concerned, as described in the article Digestive Organs, Diseases of the.

1. Imperfections of Food.—Imperfections of food, whether in quality or quantity, are among the most frequent causes of digestive disorders. A thorough knowledge of the principles of dietetics is essential, that the errors may be recognised and remedied. Since our digestive capability is limited, it is obvious that, when those limits are overstepped, the domain of disease is entered upon; and although no very absolute lines may be laid down for universal application, the general rules for quantity and kind are capable of being stated. *See* Diet.

(*a*) *Deficiency of Food.*—Except under rare conditions, such as famine, &c., this is not a common cause of disease. Of the signs and symptoms of starvation it is not needed here to treat. But there are frequent occasions when, with no deficiency in the total bulk of food taken, there is yet a serious want in one or perhaps more of the needful alimentary principles, and this is especially liable to occur in the feeding of children. Setting aside those gross cases of cruelty, when infants and the youngest children are fed almost from their birth with bread, broth, or even meat, there are still too often to be met with children whose diet-scale is almost entirely wanting in nitrogenous matter. Fed chiefly upon infants' foods, the latter consisting of little more than starchy material, their tissues are ill-formed for the want of proteids, which, during the period of growth, are required in a larger relative proportion. The relationship of rickets to prolonged suckling, with the accompanying deficiency in necessary food-stuffs, is now generally recognised.

The effect of a deficiency of food is a general state of malnutrition, in which any hereditary tendencies to disease that may exist have a more favourable field for development. There is a gradual diminution in the weight of the body, and an imperfect performance of its functions, as indicated by muscular weakness, mental lassitude, &c.

The specially dyspeptic symptoms referable to a want of food are, mainly, perversions of sensation, such as a feeling of sinking, emptiness, or even pain at the epigastrium, or generally in the abdomen. Constipation is frequent from lack of stimulus to normal peristalsis, and it is probable that tho digestive secretions are defective in quality and quantity, thereby causing imperfect digestion of the food that is taken. A weak digestion is not seldom due to want of the needful stimulation of sufficient food.

The deficiency in food taken may result not so much from a defective supply of nutriment, as from a disinclination to eat, a common symptom of many diseases, especially febrile states; self-imposed fasting too frequent or prolonged; the anorexia of the hysterical temperament; or from obstruction to the entrance of food into the stomach from stricture of the œsophagus. Or the appetite may be impaired by over-indulgence in alcohol or tobacco. *See* Appetite.

(*β*) *Excess of Food.*—There is very little doubt but that more food is daily in the habit of being taken than is actually required to restore the tissue-waste, most active lives being led on an amount far below what is ordinarily regarded as being necessary; and there is equally little doubt that much of what is taken is not in the most digestible form. It is open to question whether the appetite would be satisfied by the ingestion of merely sufficient to balance the waste, particularly if the gross bulk of the food taken were diminished by the removal, as far as possible, of all indigestible matters, leaving little more than the needful alimentary principles. At the same time it must not be forgotten that the appetite is very easily controlled by custom, and determination can in time overcome a vicious habit.

An habitual excess of food, at least in this country, usually errs in the disproportionate amount of nitrogenous matter it contains. Remembering the relatively small quantity of this principle that is essential, and in what a number of the ordinary articles of diet it occurs, this statement will be the more readily accepted. Since all the proteid principles require, to fit them for absorption into the blood, a considerable amount of chemical alteration, and, physiologically speaking, there is good reason to believe that the subsequent metabolic changes of these matters, when absorbed, are more complex than those undergone by fats and amyloids, it would follow that the organs concerned in effecting these changes are very prone to suffer from overwork and its sequelæ. Also many of the substances resulting from the metabolism of nitrogenous matter are liable to become positive poisons in the economy, and the proper elimination of such materials is specially provided for by such organs as the kidneys and skin. The frequency with which these organs become the seat of disease may at least indicate the probability of errors of diet being an important factor in determining the morbid changes, especially as considerable relief is often the result of a restriction of nitrogenous food. There can be little doubt but that the large group of diseases associated with failure in elimination of nitrogenous waste has for a prominent cause an habitual excess of nitrogenous food.

The results of an excessive ingestion of food are as numerous as they are diverse. In many cases there does not seem to be either impairment of health or shortening of life. In some obesity and in others leanness ensues. In a large majority of individuals whose food is much in excess of their wants, particularly if the exercise taken be but little, there are variable symptoms of indigestion, such as a general feeling of lassitude and want of energy, both muscular and mental, a liability to headaches chiefly frontal, constipation, or more rarely diarrhœa, high-coloured urine depositing abundance of urates, a general disposition to sleep, various skin-eruptions, particularly acne, and not infrequently a feeble heart's action from commencing fatty degeneration of its substance. Any or all of these symptoms may exist, and may be more or less completely relieved by a restricted diet. It is impossible to lay down any exact rules for the quantity of food that should be daily consumed; though it is desirable to remember that the tendency is to take too much, at the same time that age, season of year, and occupation are all circumstances determining variations both in quantity and kind.

(γ) *Improper Food.*—Setting aside those extreme cases of perverted appetite occasionally seen in the hysterical condition, there yet remains a very constant violation of the dietetic proprieties. These errors may be classed under the following heads:—1. Substances which are indigestible; either essentially so, or from imperfect preparation (cooking, &c.) 2. Substances which, though digestible, are innutritious or even poisonous. In the first group are included such bodies as the pips and seeds as well as the skins and rinds of fruits, the husks of corn and bran, the stalks and fibres of leaves, and gristle, elastic tissue, and hairs in animal food. For the reducing of these to a fluid and diffusible condition no chemical arrangement exists in the human organism, and they are voided very much in the same state as they are swallowed. Many articles of diet depend in great part for their digestibility on their proper preparation by division, cooking, &c. Thus most vegetables when taken in the raw state are but imperfectly digested, and such nutritious food as potatoes becomes when uncooked positively harmful. The apparent value of raw green vegetables, as lettuce, endive, cress, &c., would seem to depend on the peculiar condition of their mineral constituents, rather than on the vegetable tissues. Such substances as the above-mentioned are apt to produce perversions of digestion in virtue of the mechanical irritation they give rise to, indicated by more or less pain of a griping character (colic), and frequently accompanied by diarrhœa. The constant ingestion of the more formidable may even set up a gastro-enteritis, acute or chronic. Occasionally articles of food, such as brown bread, oatmeal porridge, &c., are taken for the very aperient action they induce, owing to the irritating nature of the indigestible husks they contain. Symptoms of acute dyspepsia very frequently follow the taking of meat foods enveloped in greasy sauces, since the fat, being undigested in the stomach, prevents the action of the gastric juice on the proteid matter, which then passes on into the intestines, setting up irritation like any other indigestible substance. The most interesting among those articles of diet which, though easily digested, may be poisonous, are those producing their effects only on certain individuals. Such, for example, are certain mushrooms, shell-fish, or indeed any fish. Remarkable cases are authentically recorded of serious and even fatal results following their ingestion. The symptoms may be those of an acute gastro-enteritis; or, as is very frequently the case, an urticaria is the result, with or without swelling of the eyes and throat. Severe nervous prostration has been met with occasionally. Be it understood that other people have partaken of the same diet with no ill results. The writer is acquainted with a gentleman who for many years was unable to remain in the room when fish of any kind was on the table, its presence inducing severe vomiting, abdominal pain, and general illness; and although the effects are now but slight from the mere smell of such food, very marked symptoms follow on partaking of any. The most digestible and nutritious articles of food may determine indigestion when taken too hot or too cold.

Finally must be included those substances which accidentally find their way into the alimentary canal with the food, as entozoa, ergot of rye, pins, needles, coins, buttons, &c., or lead and other poisons off the hands of workers in them, all of which give rise to definite and for the most part characteristic symptoms.

2. **Irregularities of the Mechanism of Digestion.**—The motor factors of the digestive process depend for their due and normal performance on the integrity of the muscular tissue, the nerve-centres, and the connecting nerves. The several stages of the entire process are mastication, deglutition, the churning movements of the stomach, the peristaltic action of the intestines, and defæcation. Each of these is liable to impairment, in the direction of increased activity, or of deficiency (paralysis), due either to lesions, or to reflex stimulation of the nerve-centres whence the motor stimuli emanate, of the nerve-fibres by which these stimuli are conveyed, or of the muscular tissue by which the movements are performed. Not infrequently more than one of these tissues may be at fault.

Lastly, obstructions to the movements may be caused by tumours, cicatrices, adhesions to adjacent structures, &c. Irregularities of mastication, deglutition, and defæcation are fully considered elsewhere.

(1) *Paralysis.*—Apart from possible structural affections of the intrinsic nervous mechanism of the gastro-intestinal tract—Auerbach's plexus—of which, indeed, little is known, arrest of the peristaltic action of the gullet, stomach, or intestines is undoubtedly often associated with diseased conditions of the central nervous organs; but the exact connexion is far from being satisfactorily determined. Those lesions which interfere with the action of the vagus nerve, and remove its accelerating influence over the peri-

staltic movements, have been regarded as most likely to bring about this condition; but stimulation of the splanchnic nerves, by which inhibitory impulses reach the stomach and bowels, will produce the same result. The nervous exhaustion induced by long fasting, continued vomiting, previous violent peristalsis from purgatives, hysteria, and such diseases as chronic anæmia, typhus, and puerperal fever; also over-brainwork, with the attendant altered conditions of cerebral vascularity, and extremes of blood temperature in pyrexia, or great cold, have been found to be accompanied with symptoms indicating loss of power of the muscular coat of the bowel. Possibly in these cases the result is due to arrest of the vagus influence.

Paralysis of the stomach and intestines is a frequent result of affection of these organs themselves. Inflammation of the peritoneal or mucous coats, with the subsequent infiltration of the muscular coat with the inflammatory products, materially diminishes the power of the contractile tissue. Degeneration of the organs, particularly the lardaceous variety, which, commencing in the mucous, subsequently invades the muscular coat, obviously interferes with the movements. Overdistension from whatever cause will also enfeeble the contractile power of the muscular fibres of the stomach or intestine, whilst moderate distension is the normal stimulus to their activity. If, as is supposed, the energetic contractions of the pyloric part of the stomach, whereby the chyme is propelled into the duodenum, be normally excited by the acidity of the gastric juice, it may be expected that any diminution of this acidity will lead to deficient propulsion of the contents, and their undue retention in the stomach. The movements of the alimentary canal may be considerably lessened by the administration of certain drugs, such as opium, which diminish the excitability of the augmentor centres, or stimulate the inhibitory control.

The results of these various paralytic affections are in most cases sufficiently apparent. The palsied lips and cheeks and tongue tell their own tale by the half-opened mouth, the dribbling saliva, and the cheeks distended with food which cannot be kept between the teeth. When the fauces and pharynx are affected, the painful efforts at swallowing, the rejection of food through the nose, and the passage of food into the larynx, are signs not to be mistaken. Paralysis of the stomach and intestines is mainly recognised by the constipation from inability of the canal to propel its contents, and by symptoms of dyspepsia, such as flatulence due to deficient gastric secretion from want of the requisite stimulation afforded by the churning of the stomach-contents, and to consequent delayed digestion, leading to abnormal fermentative changes. A paralytic condition of the sphincter ani will be indicated by an inability to retain the fæces. It should not be forgotten that, normally, the gastric movements cease during sleep.

(2) *Excessive activity.*—Excessive activity of the muscular structures of the alimentary canal will be manifested by an increased peristalsis of the stomach and intestine, or by tonic spasms of limited regions. The former condition, by hurrying along the contents at the expense of their proper digestion and absorption, is an effective cause of diarrhœa. The latter, which is altogether abnormal and not a mere exaggeration of a healthy action, will, in proportion to its severity and extent, determine obstruction to the passage of the food. The spasmodic affections are almost always associated with pain — intestinal cramp, colic, tormina, &c.; and varying degrees of discomfort usually accompany exalted peristalsis.

The causes leading to these states may, as in paralysis, be referred (*a*) to the cerebrospinal centres, or (*b*) to the local neuro-muscular structures. Excluding spasms of the muscles of mastication, deglutition, and defæcation, which are elsewhere treated of, increased gastro-intestinal movements (*a*) may follow on (i.) emotional states; (ii.) some structural lesions of brain and spinal cord, such as basilar meningitis and locomotor ataxy; (iii.) the increased excitability of the neuro-muscular apparatus caused by drugs—as strychnine, and septic poisons; (iv.) cutaneous irritation, as from cold, reflexly stimulating the accelerator nerves; affections of other viscera, especially uterine and ovarian, may act in a similar manner. Whilst the first- and last-mentioned causes tend to cause increased peristalsis of the canal, the other causes mentioned rather lead to tonic spasm. (*b*) Causes which may be regarded as exciting gastro-intestinal movements by their local effect may be grouped thus: (i.) irritation due to the character of the contents, such as its indigestible nature, acidity, extreme coldness or even excessive bulk, foreign bodies in the food, as pins, buttons, &c., irritant drugs, or worms; (ii.) drugs which appear to act directly on the gastro-intestinal plexuses and muscle-fibres, as lead, nicotine, &c.; (iii.) increased irritability of the mucous surface, as from inflammation or ulceration, thereby favouring the action of the ordinary stimulants to contraction. Certain blood-states, such as that occurring in the uric-acid diathesis, anæmia, or any other condition in which there is a deficiency of circulating oxygen and overcharge of carbonic acid, are liable to excite spasm or increased peristalsis, probably acting on the nerve-centres concerned, as well as directly on the tissues of the canal itself. Spasm of the pylorus, described as of occasional occurrence, is of theoretic rather than practical interest; a paralytic state of this sphincter is probably more common. The normal tonicity of the sphincter ani may give place to painful spasm, a condition which is very apt to complicate fissure and ulcer of the anus.

(3) *Mechanical difficulties.*—The due performance of the mechanism of digestion may be interfered with by alterations in the condition of the alimentary canal caused by various kinds of obstruction or dilatation. Thus deglutition may be rendered difficult or even impossible by a swollen tongue or tonsils, post-pharyngeal abscess, tumours of the œsophagus or larynx, or new-growths situated at the cardiac aperture of the stomach. The various obstructive diseases of the pylorus and intestines will obviously interfere with the proper passage of the contents, and in those dilatations of the canal which are liable to develop above a stricture, the food accumulates and is delayed in its passage. The adhesion of coils of the bowels to each other or to adjacent structures is a further source of imperfect movement.

(4) *Diseases of the teeth.*—Lastly, the subdivision of the solid food, so necessary for the effective action of the digestive juices, is only imperfectly performed when the teeth are deficient in number or are carious, and to this cause a large proportion of cases of dyspepsia may be fairly assigned.

So marked a perversion of the mechanism of digestion as vomiting is more fitly described by itself, though it is a very frequent symptom of indigestion.

3. **Imperfections in the Chemical Changes.**—Our knowledge of the normal chemistry of digestion, much as it has advanced of late, is still very far from complete; and, in face of our ignorance, but little can be said of the conditions existing in disease. Yet there are certainly no departures from the healthy working of the body so common as are those associated with the digestion of the food.

The various secretions, whose office it is to convert into a fluid and diffusible form those alimentary principles which cannot be absorbed without such preparation, are formed from the blood by the salivary, gastric, pancreatic, hepatic, and intestinal glands. It is clear that, for these juices to be secreted in proper quantity or of proper composition, the blood, no less than the secreting cells, must be in a healthy condition, and the trophic influence of the nervous centres upon the latter must be unimpaired. If the circulating fluid be laden with imperfectly secreted products of tissue-change, or if it be charged with poison, of whatever origin, it is not to be expected that a normal secretion is to be obtained from it; whilst, on the other hand, a degenerated secreting epithelium is unable to perform a function intimately dependent on the integrity of its protoplasm. Of necessity these two factors—blood and cells—react on one another; any flaw in the one is reciprocated by the other, and thus becomes intensified by mutual interdependence. Experiment leads us to ascribe the efficacy of these juices in the changes they effect to the existence in them of certain so-called ferments, whilst the result they bring about is mainly one of hydration. How far the various mineral constituents of the secretions aid in the process is uncertain, but at least their presence cannot be dispensed with. In this way, the insoluble starches of our food are converted by the saliva, the pancreatic, and possibly the intestinal juices, into soluble and diffusible sugars; the various proteids are rendered capable of absorption into the blood, by the gastric and pancreatic juices, and perhaps also the succus entericus, being changed into bodies known as peptones. The fats are prepared for absorption by the bile and pancreatic juice, by being in part reduced to a sufficiently minute state of subdivision (emulsion) to permit of their passage through the tissue-interstices, and partly by being chemically altered into soaps. However closely we may imitate the separate actions of these fluids in our test-tubes and laboratories, the conditions are undoubtedly much more complicated in the alimentary canal, where so many changes are simultaneously going on, and so many sets of products are formed.

The various secretions may be morbidly affected in respect to their quantity or composition; alterations which must of necessity profoundly modify the digestive process, though with our present imperfect knowledge we may not be able to refer with accuracy any particular symptoms of indigestion to a special change in either of the secretions.

The *saliva* may be increased in amount (*see* SALIVATION), the fluid being poor in solids and ferment. It may be difficult to trace any definite digestive troubles to this condition, since there is no evidence that the carbohydrates are insufficiently converted; but it is probable that the quantity of slightly alkaline fluid swallowed may interfere with the changes in the stomach. The general wasting which frequently follows on this state may be in part attributable to the anorexia which is so commonly associated with it. Nor can a diminution in the saliva, such as occurs in fever, be held responsible for any special dyspeptic symptom. Should the fluids of the mouth become acid, as from lactic or other fermentation of food therein, a stomatitis of varying severity may be induced, so commonly seen in infants.

Within the past few years considerable attention has been paid to the behaviour of the *gastric juice* in disease, and much valuable information has been obtained, mainly in reference to the acid constituents. The want of a reliable test for the acids has been felt, but for all ordinary practical purposes, so far as present investigation has gone, Gunzburg's reagent would seem to be sufficient for the detection of hydrochloric acid. This is an orange-brown fluid composed of 2 grms. of phloroglucin and 1 grm. of vanillin dissolved in 30 c.c. of absolute alcohol. A few drops of this, gently heated in a porcelain dish with a similar quantity of the fluid obtained by filtering the vomit (or gastric contents withdrawn by stomach-pump or syphon-tube), give a deep crimson crystalline deposit if HCl be present. Lactic acid is detected by it deepening the faint yellow tint of a very dilute solution of ferric chloride. It is now ascertained that during the earliest stage of gastric digestion of an ordinary meal, lactic acid derived by fermentation of the carbohydrates or directly from the ingesta, is alone to be found; later the hydrochloric acid becomes manifest, and at the end of digestion should be the only acid obtainable. Examination of the vomited or withdrawn gastric contents will determine the presence or absence of these acids, and their quantitative analysis may be also approximately estimated. Repeated observations have now shown that the HCl is diminished in amount in pyrexia, anæmia, certain general cachectic states, some gastric neuroses, and in chronic gastric catarrh, whilst it cannot be detected at all in most cases of gastric cancer and atrophic and degenerated states of the mucous membrane. As a means of diagnosis, therefore, the examination of the vomit in this particular becomes of great importance (*see* STOMACH, Diseases of). An increase in the amount of HCl in the stomach may be due to actual hyper-secretion following on the introduction of food, and also to an accumulation of the juice during fasting. Normally there should be no gastric juice in the empty stomach; but in some nervous diseases, such as hysteria and tabes, large quantities of fluid containing a marked excess of HCl may be vomited, independently of food, with epigastric pain and acid eructations. This condition is said to lead to gastro-ectasis and predispose to gastric ulcer. The more frequent cause, however, of 'acidity' is an excess of lactic acid from fermentation of the sugars present, and under these circumstances the HCl is diminished in amount and does not replace the former as it normally should. Butyric, acetic, and other acids of the series may also occur as results of fermentation of the stomach contents. Facts concerning the variation in quality or quantity of the pepsin are wanting, but it would appear to vary with the hydrochloric acid; and the same may be said of the rennet ferment. The efficacy of the gastric juice is impaired by the presence in the stomach of strong alcohol or of bile, which precipitates the pepsin; and an excess of mucus, such as occurs in gastric catarrh, acts prejudicially by preventing the food coming in sufficiently close contact with the secreting surface. During sleep, also, the gastric secretion is diminished.

Notwithstanding that the normal *pancreatic juice* effects active digestive changes in the proteid, fat, and carbohydrate constituents of the food, the results which follow its deficiency in quantity or quality cannot be indicated with precision; possibly its absence may be in part compensated for by the bile and intestinal secretion. It is not to be forgotten that its effective working largely depends on the previous gastric digestion having been properly carried out. There is no doubt but that in many cases, when the pancreatic fluid is completely cut off from the duodenum, the digestion of fats is very considerably interfered with, as shown by the character of the stools, and the rapid emaciation of the patient; but this result is not invariable, and is certainly most marked when the bile is also wanting. In fever the secretion is said to be diminished.

An excessive secretion of *bile* is not clinically recognised except as the result of the administration of certain drugs, but a deficiency or complete absence is of common occurrence in those morbid states associated with obstruction of the bile-ducts, and, to a less degree, in fever. The dyspeptic symptoms directly referable to this state are specially due to the impaired fat digestion, as evidenced by the clayey fœtid stools. Abnormal fermentations, manifested by flatulence, may also take place. The absence of bile further exerts a prejudicial effect on the course of proteid digestion, from the failure to neutralise the acid chyme and consequent precipitation of peptones and arrest of peptic fermentation. The exact changes which ensue are unknown, but there is little doubt that the duodenal digestion of proteids is seriously interfered with by the absence of bile.

So little is known of the action of the *intestinal juice* in health, that nothing can with certainty be affirmed of the part it may play in disease. It is really doubtful which of the alimentary principles it can affect, or whether its action is not limited to effecting further changes in the already partially digested food-stuffs. An excess of the secretion appears to occur, and to form the bulk of the fluid in the diarrhœa of cholera, which may be compared to the salivation and gastric hyper-secretion of certain nerve-states.

In addition to the changes in the ingesta effected by the above-mentioned secretions, there is reason to believe that similar changes of a solvent character may be brought about by the action of *micro-organisms* in the stomach and intestines. Recent observations have demonstrated that numbers of these fungi are normal inhabitants of different parts of the alimentary canal, and that certain species are peculiar to special regions. Originally introduced *ab extrâ*, they propagate enormously, at the same time being subject to great variation in number, and to some extent in kind, with the food taken. These microbes would seem for the most part to play a minor part in ordinary digestion; although the lactic-acid fermentation of carbohydrates in the stomach, and certain changes in the proteids in the duodenum, resulting in the formation of such bodies as indol, are to be ascribed to their agency. How far, however, such changes are normal and essential is uncertain; but there is no doubt they may be very readily induced and very considerably extended—such as the butyric- and acetic-acid fermentations. In this way may be formed other products of putrefactive decomposition—ptomaines and tox-albumens—often of a poisonous character, and mainly responsible for many remote dyspeptic symptoms; as well as accumulations of such gases as carbonic acid, hydrogen, sulphuretted hydrogen, and marsh-gas, productive of all degrees of flatulence. The exact conditions which permit these abnormal fermentations are not known with certainty. Delay in the propulsion of the gastro-intestinal contents is probably an important factor; and still more so is the proper composition and quantity of the different digestive secretions, by which the activity of many toxic organisms is undoubtedly held in check. Diseases such as cholera and enteric fever, due to specific germs, are not ordinarily accounted as 'disorders of digestion,' though many of their most marked symptoms as well as anatomical lesions are connected with the digestive system.

4. **Deficient Absorption of the Digested Products.**—This may reasonably be supposed to cause indigestion, as it certainly does the subsequent impairment of nutrition. The accumulation in the stomach and intestines of materials which should have been gradually absorbed into the blood or chyle vessels must interfere with the healthy action of the digestive secretions, much in the same way, probably, as the alcoholic fermentation of sugar is arrested in time by the presence of the very products of such fermentation.

Data for estimating the normal rate of absorption from the alimentary mucous membrane of the ordinary results of digestion are very imperfect; and, until they are more clearly ascertained, it is not possible to diagnose with certainty this functional defect, though its existence may often be inferred with much probability, and may suggest modifications in the size if not in the quality of the meals taken

Conditions upon which an impaired absorption of the digesta may be assumed to depend, are (i.) failure in converting the food to a diffusible state from inefficiency of the secretions; (ii.) impaired peristalsis, whereby the materials are not brought into sufficiently close contact with the mucous membrane; (iii.) deficient circulation of the blood and lymph in the chylopoietic area, and consequent hindering of osmosis; (iv.) disease of the vessel-walls, impairing their permeability; and (v.) degeneration of the epithelium, with the same result.

SYMPTOMS OF DYSPEPSIA.—The almost numberless symptoms which indicate the perverted functions above described, and are primarily dependent on morbid structural changes in the organs concerned, may be conveniently grouped into *local* and *remote*. Many so-called dyspeptic symptoms, however, are more properly referable to subsequent perversions of metabolism than to actual digestive imperfections.

The *local* symptoms—those, that is, which are connected directly with the affected structures—are, perversions of sensation; constipation or diarrhœa; vomiting; pyrosis and acidity; hæmatemesis; flatulence; eructation and foul breath; salivation or dry mouth; morbid states of the tongue; abnormal character of the stools. Excepting the first-mentioned, these receive detailed description in the present work under their respective headings.

Ordinarily we are unconscious of the process of digestion, but in disease the function may be accompanied by alterations of sensation varying from a mere sense of weight and discomfort in the abdomen to the severe spasmodic pain of colic. Such, however, are not constant, for very definite indigestion may exist without the patient ever complaining of abdominal sensations. The ingestion of food may be followed by a feeling of abnormal repletion, or of emptiness with craving for food; or there may be heartburn, an ill-defined sense of burning felt in the epigastrium or over the chest or extending to the throat; or positive pain, or tenderness over some tolerably definite area. Sensations as of excessive movements of the bowels, of sinking, or of tightness across the abdomen are of frequent occurrence.

Among the numerous *remote* symptoms are pain in shoulder, back, or limbs; headache—frontal, occipital, and vertical; vertigo and giddiness; muscæ volitantes; tinnitus aurium; cramps in the limbs; muscular weakness; palpitation, cardiac irregularity, flushings, and anginous attacks; cough and singultus; impaired appetite; all degrees of mental perversion, from irritability to apathy and hypochondriasis; drowsiness or insomnia; a peculiar sallow, muddy-looking skin; various cutaneous eruptions, chiefly papular; jaundice; and abnormalities of urine. Mal-digestion may also determine a condition of fever, which may be so severe as to reach the typhoid state and end in coma. Such general perversions of nutrition as wasting and obesity may result from indigestion. Many of these symptoms may be regarded as reflex in causation, such as distal pains and cough, the afferent nerve-path for which is probably the vagus; others are doubtless to be attributed to actual want of proper materials for the nourishment of the tissues, owing to their improper preparation in the alimentary canal; and others again are possibly toxic in character, due to poisonous substances produced in the course of the perverted digestion.

The extreme diversity of these symptoms is remarkable: there is scarcely a function of the body that may not be implicated in the disturbance of digestion, and contribute its share to the total symptoms of any given case. The degree to which these manifestations may be present is, moreover, most varied: in one patient the malady may be mainly represented by a headache, in another the evidences of illness are most numerous. And, again, the different ways in which these symptoms are associated in different cases are almost as many as the cases themselves. It is impossible, therefore, to attempt any description of a case of indigestion which shall have other than the most limited application; and since the symptoms set forth find their fuller explanation elsewhere in this work, the bare enumeration of them must suffice here. It is important to remember that many of the symptoms mentioned as indicative of disordered digestion are of not infrequent occurrence in the course of maladies quite distinct, or at least primarily so, from digestive diseases: headache, vomiting, cough, palpitation, &c., are illustrations of this. So that, although the recognition of the symptoms be not difficult, care and experience are needful to ascribe them to dyspepsia. But supposing that causes other than indigestion have been excluded, there still remains the task of referring the manifestations of disease which any case may present to their causal perversions in the digestive process: to determine, that is to say, what may be the morbid change which has taken place in the secretions and consequent chemical processes, or the disturbances of motility, or may be the error of diet; and, if possible, to infer beyond these conditions the underlying structural lesions. The intimate interdependence of the various factors of digestion renders the discrimination of the primary fault, from the symptoms present, a matter of exceeding difficulty; and it is this which makes the accurate diagnosis of a case of dyspepsia so uncertain, and its treatment often so empirical. Many of the signs and symptoms, without doubt, indicate with tolerable certainty the region of the alimentary system which is at fault, and may even suggest the nature of the disease; but how far, and in what manner, morbid change in one part of the canal, or at one stage of the digestive process, may determine subsequent changes, and what the exact nature of these may be, and their relation to the symptoms manifested, are data at present almost unknown. The progressive character of the function of digestion—that is to say, the continuous series of stages, whereby the later ones are dependent on those preceding—renders affections of this system very different in their detection from those of other organs. Alterations in the physical characters of the digestive organs, such as a dilated stomach or an enlarged liver, may usually be ascertained with accuracy, and some symptoms may be reasonably asserted to follow from these conditions, whilst their relation to other morbid manifestations is often of doubtful inference. Modifications in the quantity or quality of the digestive secretions may be demonstrated with certainty, but their connexion with many of the symptoms which may be present is often most obscure. And, again, there may be most persistent and serious disturbance of digestion, with severe discomfort to the patient, and it may be quite uncertain which organ is primarily at fault, and still more doubtful what the real morbid change is. So far as individual symptoms may be referred to definite diseases of the various digestive organs, this is attempted in the articles treating of the diseases of the stomach, intestines, liver, pancreas, &c., which are complementary to this section.

Treatment.—The essential basis for the successful treatment of indigestion is the recognition of the cause. Oftener perhaps than may be supposed this is a removable one; in every case it must be well sought for, and corrected if possible. A carefully regulated diet, both as regards ordinary food and special idiosyncrasies, is all-important, and the means from which much good is to be expected, both by way of prevention and cure. To lay down a requisite diet entails a general knowledge of the average composition of food-stuffs and of the changes which they normally undergo in the process of digestion, together with the nature of the influence exerted by various ingredients of the food upon the digestion of the others—*e.g.* 'the retarding effect of tea and coffee on peptic digestion' (Roberts). Whether or not any given article of diet should or should not be allowed must depend upon its digestibility in the given case, apart from what may be its value under healthy circumstances, and also upon what harmful by-products of digestion it may give rise to under the diseased conditions which may be present. Exact information on several of these points is not yet available, and at the same time it is to be remembered that articles of food which normally are regarded as of the most digestible and innocent character may at times seriously disagree, whilst most indigestible articles may be taken with impunity. The writer is convinced that, whilst fully recognising the great importance of diet, it is nevertheless the case that not a few dyspeptics may trace their ailment to a long-continued adhesion to a strict diet which might theoretically fulfil all physiological requirements, and that many cases of indigestion may be considerably benefited by a laxity which might not always be justified on physiological grounds. As useful adjuncts to dietetic treatment are the various artificial partially or wholly digested food-stuffs, such as maltines, peptones, and emulsions of different kinds. Such details of general hygiene as exercise, bathing, occupation—mental and bodily, change of scene and air, require attention scarcely, if at all, secondary to diet. Undoubtedly, much may be done with drugs, both in relieving the symptoms and in treating the conditions on which the symptoms may depend. The latter are met by such means as abstinence from food for periods, with consequent rest to the organs concerned, the requisite nutriment being supplied *per rectum*; by artificially digested aliment, thus helping the digestive juices; and by supplying the elements of the secretions—acids, alkalis, and ferments, when there is reason to suppose they may be deficient. Irregularities of movements of the canal may be remedied by such drugs as strychnine, nux vomica, belladonna, and opium, or more active aperients or astringents. Pain and other sensory disturbances of the stomach or intestines may be relieved by alkalis, bismuth, hydrocyanic acid, morphine, or opium. Among the long list of drugs whose value is assured in different cases of dyspepsia are arsenic, iron, the vegetable bitters, silver, creasote, charcoal, valerian, the hyposulphites, and the various carminatives.

CONCLUSION.—In the foregoing remarks no attempt has been made to enter into a detailed description of the various symptoms of disordered digestion, or to do more than indicate very generally the treatment to be followed. Such subjects are left to the diseases treated of in their respective sections. Nor has it been thought desirable in this article to treat the subject from the ill-defined point of view of 'varieties of dyspepsia.' Rather it has been sought to bring the matter of indigestion within the limits of an anatomico-physiological basis, since it is only on such lines that the protean symptoms of dyspepsia can be accurately defined. At the same time, whilst for clearness the various causes have been made to assume a somewhat tabular form, it is not intended that the interdependence of these states should be overlooked, or to suggest that one only of the causes mentioned is at work in any given case. The complexity and harmony of our functions alike forbid such a mistake being made. Yet for that mental analysis which the formation of a diagnosis presupposes, some such scheme as the foregoing is essential, no less than for the adoption of a rational treatment.

W. H. ALLCHIN.

DIGESTIVE ORGANS, Diseases of the.—The organs comprised in the digestive system have for their function the preparation of the solid and fluid ingesta of the body, so as to fit them for absorption into the blood. Some of the food requires little or even no such preparation; some needs considerable treatment, both physical and chemical. To effect this object it would appear to follow that there should be some receptacle or series of receptacles into which the food may readily be taken, and from which the worthless residue may escape, provided with muscular structures to ensure a movement of its contents. It would further follow that there should be certain organs communicating with the foregoing, whose function it should be to prepare those materials necessary to effect the required chemical changes in the food; and, lastly, that some arrangement should exist to permit of the ready absorption of the digestive materials. Such requirements we find supplied in the alimentary canal, with its terminal apertures, and its continuous muscular coat so arranged as to maintain a progressive advance of the contained food, though with varying degrees of speed—for some lengths, as through the gullet, without any arrest; through others, as the stomach, with considerable delay. Into this canal open numerous glands (mucous, salivary, gastric, intestinal, hepatic, and pancreatic), the secretions of which play each their special part in the conversion of the food to a fluid and diffusible state. From an anatomical, and indeed a genetic, point of view, these glands may be regarded as more or less complicated diverticula of the mucous surface. In order that the food when so treated may gain a ready entrance into the blood, the surface of the canal in contact with the digesting food—mucous membrane—offers various modifications—villi, &c.—to facilitate the process of absorption. Lastly, in beings so complex in structure as man, there is need for some controlling influence to bring the operation of this system of organs into harmony with the actions of other and interdependent systems. Such power of co-ordination is exercised *viâ* the nervous system, sympathetic and cerebro-spinal.

By the expression 'diseases of the digestive organs' is meant, departures from the normal structure of the tissues of which these organs are composed.

The constructive tissues of the alimentary organs are:—(1) the Epithelial; (2) the Connective, including the Lymphoid; (3) the Muscular; (4) the Nervous; and (5) a compound texture—the Vascular. Each of these is subject to its own perversions, either alone or in common with others.

ÆTIOLOGY.—If we consider diseases to be altered functions dependent on altered structure, the latter being determined by some perversion in the normal stimuli to nutrition, either hereditary or acquired, we shall at once recognise that the opportunities for abnormal stimulation in the case of the digestive organs are most numerous. Communicating with the external world, and continuously subject to the admission of foreign matter, we have in the character of the ingesta abundant sources of disease. Toxic agents, living and dead, find ready entrance; and excesses in quantity of food, no less than imperfection in its quality, alike serve to produce those departures from the normal structure on which perversions of function depend. Furthermore, the tissues of the alimentary viscera are, equally with those of the body generally, subject to those more obscure hereditary influences which determine irregularities in structure and their sequence. And, finally, arrests in development of organs, not infrequent in those under consideration, complete the list of possible diseases to which the alimentary system is liable.

Nor is this system independent of morbid conditions affecting other organs. So complicated as is the human body, it is impossible that disease should for long be limited to one region. Sooner or later the functions which are acting the one with the other, to constitute the harmonious working of healthy life, will feel the effects of the one that is out of gear, and will respond each in its own manner to the abnormal condition of its environment. A disease primarily located in the nervous system will produce an effect in the working of the nutritive functions, none the less real because the exact lesion cannot as yet be determined. Failures in elimination of the products of tissue-waste, from structural diseases of the excretory glands, must tell back on the organs concerned in the preparation and elaboration of the ingesta; and such conditions constitute a frequent cause of disorders of digestion. The causes may be thus tabulated:—

A. Hereditary.
  1. Arrests in development of tissues and organs.
  2. Abnormal nutritive stimuli, determining new-growths, &c.

B. Acquired.
  1. Poisons.
  2. Imperfections in quantity or quality of normal ingesta.
  3. Failure of excretory functions, with consequent circulation of an impure blood, and malnutrition of tissues.
  4. Trophic disturbances acting *viâ* the nervous system.
  5. Traumatic.

VARIETIES OF DISEASE OF THE DIGESTIVE ORGANS.—There is scarcely any form of diseased structure that is not to be met with in the tissues comprising the digestive organs. Since almost every variety of texture is found in them, and there is so extensive a liability to the causes of disease, this result is only to be expected.

I. Affections of the Vascular State. Regarded collectively, the organs of digestion present several points worthy of remark in respect to their blood-supply. First, the arrangement of the vessels is such as to ensure a very extensive, and at the same time very direct, supply. The arteries to those alimentary organs situate in the abdomen are almost all primary branches of the aorta; and this, together with the numerous and free anastomoses between them, reduces to a minimum the chance of failure in circulation. Secondly, the blood from the same area is all collected into one large vein—the portal—and after circulating through the liver is carried by one—the hepatic—directly into the inferior vena cava, close to the right auricle. Such an arrangement, whilst considerably reducing the speed of the blood-flow through the hepatic capillaries, offers a double chance—viz. in the liver and in the heart—of producing a general state of congestion of the alimentary organs. Thirdly, the existence of such an organ as the spleen, which by its position and structure, as well as its periodic rhythmic contractions, allows of great variation in the amount of blood it contains, will materially affect the extent of vascularity of the digestive organs. And, lastly, the alimentary organs probably undergo, within normal physiological limits, a wider variation in amount of blood than does any other system. The *post-mortem* appearances of the vascularity of the canal, both normal and morbid, are most deceptive, and give little or no indication of what actually exists during life. This is due in great part to the constriction of the vessels after death, and a consequent bloodless state of the tissues.

1. *Hyperæmia.*—Hyperæmia is here taken to mean an excess of blood in the arterial side of the capillaries. How far a determination of blood to the alimentary canal may exist, unaccompanied by any change in the tissues, is a matter of doubt: it rarely if ever leads to any recognisable morbid state. In the normal process of digestion this condition obtains, but with it there is an alteration in the glandular epithelia, if in no other tissue-elements. It is conceivable, however, that a vaso-motor paralysis with consequent fluxion may occur, and such may be the case in certain mental states, as indicated by diarrhœa. The majority of circumstances that produce hyperæmia do not stop at that point, but bring about a state of catarrh and inflammation, in which the epithelial and connective tissues are also engaged.

Among the digestive glands, the liver undoubtedly manifests states of simple hyperæmia without any appreciable changes in the hepatic tissues. Excessive feeding, irritants such as spices and alcohol, hot climates and malaria, suppressed menstruation, have all been recognised as producing temporary enlargements of the liver from active vascular engorgement, although without doubt these causes if continued lead to structural affections.

2. *Congestion.*—An excess of blood primarily in the venous side of the capillaries, brought about by some impediment to the return of the blood in the veins, has little or no analogy with any normal physiological action. As a condition of disease it is more important and far more common than the preceding.

There are two chief causes leading to its occurrence: (A) It may be part of a general congestion due to obstruction at the right side of the heart from tricuspid dilatation. Owing to the very direct communication of the veins of the chylopoietic viscera and the right auricle, these organs are among the first to experience the effects of the cardiac obstruction. (B) Obstruction through the portal circulation in the liver, either by compression of the portal capillaries by cirrhosis, &c., or by pressure on the portal trunk by enlarged glands, tumours, &c., will directly produce congestion of the gastro-intestinal tract and pancreas. Congestion of the alimentary canal and glands, when due to either of these causes, is in the main progressive in its nature, though occasionally liable to temporary variations in degree.

As a rule, changes which are strictly limited to alterations in the fulness of the vessels are not to be detected with certainty after death; but extreme conditions, especially if associated with any hæmorrhage into the sub-epithelial tissue, may present *post-mortem* appearances often mistaken for irritant poisoning.

3. *Results of Increased Vascularity.*—(*a*) *Hæmorrhage.* Over-fulness of the capillaries, from whatever cause, is liable to lead to extravasation of blood, either by diapedesis of the corpuscles and transfusion of the fluid part of the blood, or from actual rupture of the vessels. It is much more common and far more extensive in venous congestion than in arterial hyperæmia. It must not be too readily assumed *post mortem* that either of these conditions alone is the cause of the hæmorrhage, since minute ulcers of the mucous membrane communicating with main vessels have been met with. Dependent on the cause and situation, the effused blood may vary in colour from bright red to a coffee-ground appearance. Hæmorrhage may be also due to altered states of the blood, such as purpura and scurvy. (*β*) *Œdema.* An over-distension of the vessels, especially of the veins, if it be at all persistent, is invariably accompanied by an effusion of serum into the substance of the viscera themselves, and into the alimentary canal, in the latter case producing diarrhœa. (*γ*) Tissues the seat of a chronic congestion in time undergo certain structural changes as the result of their impaired nutrition, resulting in *atrophy* or *degeneration*; or they may be characterised by the presence of an excessive amount of connective tissue, containing fewer protoplasmic elements than normal, and exhibiting a marked tendency to contract. This *fibroid substitution* may occur throughout the entire digestive system, but is particularly noticeable in the stomach, intestines, liver, and pancreas. (δ) Another result of a long-continued congestion is to develop—often to an enormous extent—collateral circulations, especially at the points of communication between the vessels of the portal and systemic areas; *e.g.* the connexions between the gastric and œsophageal veins around the cardiac orifice, and by the latter with the phrenic, intercostal, and azygos veins, and thence with the inferior vena cava, or the junctions between the hæmorrhoidal veins and branches of the internal iliacs. Considerable compensation is thereby very frequently established, but the over-distension to which the vessels are subject especially favours their rupture.

4. *Anæmia.*—The alimentary viscera, in common with the rest of the body, may share in a general bloodlessness due to excessive loss or extreme malnutrition from wasting disease, &c. A deficiency of blood limited to these organs is not clinically met with.

5. *Infarctions.*—As compared with the brain, spleen, and kidneys, the organs of the alimentary system would appear to be less prone to suffer from emboli and thrombi, or at all events from the effects of these obstructions. A partial exception to this general statement must be made in the case of the liver, which is a frequent seat of abscess determined by the arrest in the portal capillaries of septic particles taken up by the portal radicals in dysentery, &c. Any of the vessels of the liver may be occluded by emboli, or thrombosis following on endarteritis or endophlebitis, but they are conditions of very rare occurrence. The superior mesenteric artery has been known to be blocked by an embolus, with consequent infarction and profuse intestinal hæmorrhage. Minute emboli in the gastric arterioles, or thrombosis from degeneration, atheromatous or hyaline, of these vessels is an undoubted cause of ulcer of the stomach, though not the only one.

II. Structural Affections.—1. *Inflammation.*—This term is applied to express those changes which take place in the nutrition of a tissue subsequent to the application of some abnormal stimulus which shall not have been sufficiently powerful to produce destruction. The changes in the structural elements of the textures result partly in the production of some material which is unlike the normal constituents of the part affected, and partly also in certain destructive phenomena. One or other of these phases may predominate, as suppuration and abscess or ulceration, &c. Certain variations present themselves in the nature of the new-formed material, and also in the general course of the process, constituting forms of inflammation, as simple catarrhal, diphtheritic, phlegmonous, &c. In vascular tissues there are, in addition to the tissue-changes, certain alterations in the circulation in the affected region, commencing with hyperæmia and leading to a variable amount of stasis and œdema.

Inflammation as it affects the alimentary tract offers no exception to this description. It is rare for the muscular tissue to share in the process, which is practically limited to the epithelium, mucosa, and submucosa. The transition, so far as anatomical appearances are concerned, from the normal state of activity of the organs, with their increased vascularity and cloudy appearance of the epithelial cells, to that of simple inflammation or catarrh, is but a step marked by no abrupt line.

Different sections of the entire canal appear to be more prone to certain forms of inflammation than are others. It is unusual for the whole length to be involved, and certain regions, notably the jejunum, are but exceptionally affected. The mouth, pharynx, stomach, lower part of the ileum, and colon are the usual seats. *Catarrhal* inflammation, characterised by intense redness and swelling of the mucous membrane, with an excessive secretion, mucous or serous, and desquamation of the epithelial cells, is of commonest occurrence almost throughout the canal (*see* STOMATITIS; STOMACH, Diseases of; and INTESTINES, Diseases of). When but limited areas are affected and the cause is removed, this condition runs an acute course and tends to recovery; but when the greater part of the canal is involved and the cause is of specific virulence, the effects are more serious. This is the case in cholera, whether of the Asiatic or English type, the anatomical lesion of which is essentially an intestinal catarrh. It is noticeable that the epithelia of this tract are but little prone to manifest a purulent inflammation, as is so characteristic of some other mucous surfaces, such as the nasal, bronchial, and vaginal. *Phlegmonous* inflammation, probably bacterial in origin, corresponding to erysipelas of the skin, and distinguished by the formation of pus in the mucosa and submucosa, represents a more severe inflammatory process, accompanied by a more severe constitutional disturbance. It is of most frequent occurrence in the fauces and tonsils, where it is common (*see* TONSILS, Diseases of), and far more rarely in the stomach, where it constitutes a very serious disease. Under the term *membranous* or *pellicular* are included those forms of inflammation in which the new material assumes the form of a false membrane on or in the mucous surface. This is represented in the mildest degree by aphthæ, which characterise a special form of stomatitis, and are small patches of coagulated exudation from the blood involving leucocytes and the deeper layers of the stratified oral epithelium. After a day or two's duration they break down and are thrown off, leaving an abrasion or not according to the extent to which the tissues are included in the patch. The more severe forms of inflammation associated with formation of false membrane are termed *croupous* and *diphtheritic*, words which have been extensively misapplied, with much resulting confusion. The former denotes that form of inflammatory product which consists of a coagulated fibrinous exudation effused among the necrosed epithelial cells and into the mucosa, together with many leucocytes and a few red blood-cells; in the latter, the necrosis of the tissue-elements is more extensive and the adherence of the membrane is more intimate. The fauces are by far the most frequent seats of these states, but patches of false membrane are of occasional occurrence in the stomach, and more commonly on the edges of the saccules of the large intestine. It is doubtful, however, whether such membranes are diphtheritic in the clinical sense of the term, however closely they may correspond in anatomical characters.

An acute or sub-acute attack of catarrhal inflammation of the stomach or intestines is likely, if the cause persist, to become chronic, the structural features of which are especially an atrophy of the epithelium, with or without much fibroid thickening of the mucosa. The wasting of the epithelium is often very marked, and when the villi also become shrunken the surface of the mucous membrane appears smooth and glazed over large areas. In young children this atrophy appears frequently to follow a single attack of acute intestinal catarrh. Some forms of stomatitis, though persisting a long time, can scarcely be said to be chronic in the sense of leading to permanent structural changes; the utmost that occurs is a thickening of the epithelium, which usually disappears in time. The fibroid overgrowth may affect the stomach or parts of the intestine tolerably uniformly, or not infrequently form polypoid elevations.

Certain peculiarities in the inflammations of special regions, such as the cæcum, colon, and rectum, are fully described elsewhere. *See* CÆCUM, Diseases of; RECTUM, Diseases of; and TYPHLITIS.

The accessory glands (salivary, pancreas, and liver), which genetically are but diverticula of the primitive digestion-tube, essentially consist in the adult state of a glandular epithelium arranged in various ways and supported by a connective-tissue stroma which carries vessels, lymphatics, and nerves. In structure, therefore, they correspond to the mucous membrane of the alimentary canal, and, like it, they are subject, though much more rarely, to similar inflammatory changes. The communicating ducts of these organs with the mouth and duodenum respectively are lined by a mucous membrane continuous with that of the cavities into which they open. Catarrh of the ducts, usually caused by extension or by the irritation of calculi, may be acute or chronic, and may lead, by the retention of the secretions from the blocked lumen, to inflammation and other changes in the proper gland tissue.

The causes of inflammatory affections of the digestive organs are very numerous. Among those which may be regarded as predisposing are (i.) the exposure of the mucous membrane to injury or irritation from injurious ingesta; (ii.) age, which confers special liability, as witness the frequency of stomatitis and gastro-enteric catarrh in children; (iii.) season, such as extremes of heat and excessive moisture, which are most active in determining epidemics of gastro-intestinal inflammations; (iv.) morbid conditions of the mucous membrane, more especially chronic congestion and degeneration, which favour the development of the catarrhal state. Exciting causes are (i.) the nature of the ingesta, whether mechanically or chemically irritating, corrosive poisons, toxic micro-organisms, ptomaines, and other bodies which may occur in the course of mal-digestion; (ii.) catching cold; (iii.) dentition; (iv.) wounds or malpositions of the bowels, herniæ, &c., impacted fæces; (v.) extension from the peritoneum; (vi.) the irritation of new-growths; (vii.) secondary to many acute febrile states, and some chronic diseases, such as phthisis and diabetes.

Among the chief results of inflammation are:—

(*a*) *Abscess.*—This may occur in any part of the submucous tissue, in the so-called phlegmonous and pyæmic inflammations, but is of most common occurrence in the gums—gumboil, in the tonsils, and in the liver; often in the latter situation it is the result of inflammation determined by absorption into the mesenteric veins of septic particles from dysenteric ulceration.

(*β*) *Ulceration.*—The mucous membrane of the alimentary canal is particularly liable to this morbid process. Some preference is exhibited for the different forms of ulcer by certain regions of the canal, and a difference exists in the tendency to perforate the entire thickness of the tube, those of shorter duration frequently producing this result, whilst the chronic ulcers are usually accompanied by a slow formation of indurated connective tissue, which proceeds *pari passu* with the destructive process, and is especially likely to institute adhesions between the canal and adjacent organs. Ulcers are met with in the salivary, hepatic, and pancreatic ducts, very frequently as a sequence of inflammation determined by the passage of calculi.

The ulcers which are usually acute in their course are:—(1) Simple or catarrhal. (2) Aphthous. These forms, though they may occur in any part of the mucous membrane, are far more commonly situated on the gums, cheeks, tongue, and palate. (3) Acute specific ulcerations: as diphtheritic and scarlatinal, mainly affecting the fauces; or typhoid, limited to the jejunum and ileum, and originating in the solitary and agminated glands. (4) Dysenteric.

The ulcers that are commonly chronic in their course are:—(1) Gastric. (2) Tubercular, which may occur in any part of the canal, but are usually limited to the same situation as the typhoid. (3) Syphilitic, most common in the mouth, fauces, and rectum. (4) Cancerous. (5) Dysenteric and chronic catarrhal.

(*γ*) *Sloughing and Gangrene.*—The inflammatory state may be so intense as to lead to molar death of the area affected, with the production of slough. This often follows scarlatinal inflammation of the fauces, and the surface of the large intestine in dysentery is frequently covered by large and numerous sloughs.

Gangrene is almost entirely limited to the mouth in children, when it produces the condition termed noma. The cheeks are usually affected first, the process rapidly involving the gums, jaws, &c. Portions of bowel that have been strangulated readily become gangrenous.

Post-mortem softening and destruction of the stomach and intestines is frequently met with, and is due to an actual digestion of the viscera by the gastric juice, which, thus escaping from the stomach, may cause destruction of adjacent organs. It is usually met with when death has occurred during the process of gastric digestion, and is more common in infants, possibly from the greater acidity of the products of digestion.

2. *Hypertrophy.*—A general overgrowth of the normal tissues of the digestive organs is practically unknown. Certain parts may manifest this condition, notably the muscular tissue of parts of the canal above an obstruction. Patches of hypertrophied epithelium are seen in the mouth following on persistent mechanical irritation of broken teeth, &c., or as the result of syphilis. The overgrowth may be limited to the epithelium of the lingual papilla. Considerable hyperplasia of the sub-epithelial connective tissue may be caused by a chronic inflammation of any part of the canal. The liver is described as being occasionally hypertrophied in certain cases of diabetes.

3. *Atrophy.*—The alimentary organs may share in the general atrophy and wasting of old age or inanition. This condition is apt to follow disease of certain parts, especially the epithelia in chronic inflammation, or

may be seen in the thinning and shrinking of the stomach and intestines beyond an obstruction or an artificial anus, or when these organs are permanently dilated. Pressure on the organs, as by tight-lacing, &c., may lead to the same result.

4. *Degenerations.*—Those morbid processes to which the term 'degeneration' is applied, and which essentially consist in the conversion of the tissues into materials of a less complex chemical composition than normal, associated with a diminished vital activity, may affect any or all of the structural elements of which the digestive organs are composed. Albuminoid infiltration or cloudy swelling is the invariable accompaniment of inflammation of the epithelial and muscular tissues. Fatty degeneration is a further result of inflammation or of other malnutrition, and has been found in the gastric mucous membrane, as well as in the muscular coat at various parts of the canal. Although not the commonest organs to be so affected, yet not infrequently the intestine and stomach are the seat of lardaceous degeneration, not always limited to the vessels, but affecting also the epithelial, fibrous, and muscular coats. The liver is especially liable to undergo degeneration, both fatty and lardaceous.

Deposition of pigment may be found in the deeper epithelial strata of the mouth and intestines in Addison's disease, in the gastric and intestinal mucous membrane as the result of changes in effused blood associated with chronic inflammation, and in the liver in certain cases of blood diseases and intermittent fevers. The sulphides of such metals as lead may be deposited in the mucous membrane of mouth or intestines in lines and spots of black or bluish appearance.

5. Changes in or retention of the secretions of the various glands may result in the production of *calculi*—salivary, pancreatic, or biliary.

6. *New-growths.*—There is scarcely any known form of neoplasm which may not be found in some region or another of the alimentary tract.

The new-growths limited to the epithelial coat, or commencing in it, are condylomata, papillomata, and various forms of carcinoma.

In the fibrous tissue occur sarcoma, fibroma, myeloid, adenoid, gumma, enchondroma, and lipoma.

In addition there may be polypi or tumours of the mucous membrane; myxoma; muscular-tissue tumour; cysts; vascular growths, such as nævi and hæmorrhoids; and the infective granulomata, viz. tubercle, lupus, and syphilis.

7. *Traumatic.*—Certain parts of the alimentary tract are, from their position, more liable than others to external injury. Incised and punctured wounds of the mouth, œsophagus, stomach, intestines, and liver are of occasional occurrence, and rupture of the abdominal viscera is sometimes met with. The ingestion of corrosive substances may produce destruction of certain parts of the canal, and wounds may be determined by foreign bodies, as pins, fish-bones, &c., which have been swallowed.

III. Malformations and Malpositions.—1. *Hereditary.*—Of these the most important are hare-lip; cleft palate; macroglossia; fistulous communication between the pharynx and the exterior, or between the gullet and trachea; intestinal cæca; imperforate anus; and herniæ.

2. *Acquired.*—Malformation and malposition of the viscera may follow from disease. Communications between the stomach and intestines, or between different coils of intestine, or between the gall-bladder and the gut, may result from chronic ulceration. Many herniæ are not developed until long after birth, from violent strains, &c.

Stricture of various parts of the canal is frequently associated with the healing of ulcers, and with new-growths. Dilatation of the canal is apt to occur on the proximal, and contraction on the distal side of such strictures. The intestines may be considerably displaced from adhesions following peritonitis. Twists (volvulus), intussusception, internal strangulations, and prolapsus ani, are more or less common affections of the intestines.

IV. Abnormal Contents. — *Concretions.*—These are found occasionally in the saccules of the large intestine, cæcum, appendix, and, more rarely, stomach and small intestine. They usually are made up of concentric layers of earthy and organic matter, the former being principally phosphates of lime and magnesia. They frequently have as a nucleus some foreign body. Similar bodies have been met with, formed of chalk, magnesia, or oxide of bismuth, which have been swallowed. Much larger masses, mainly composed of densely felted hairs or vegetable husks and fibres, with earthy and fæcal matter, are sometimes seen; gasteroliths are generally of this variety (*see* CALCULI). Foreign bodies, such as pins, bones, fruit-stones, coins, &c., may also lodge in the alimentary canal.

Parasites.—The alimentary organs are infested by numerous forms of micro-organisms, belonging for the most part to the vegetable kingdom. The greater number are comprised in the Schizomycetes, or bacteria, but a few, such as the Actinomyces, found in the mouth and liver, are included in the division Hyphomycetes, or moulds; and as an example of the Blastomycetes, or yeasts, may be mentioned the thrush-fungus, Saccharomyces albicans.

These all obtain entrance to the canal from the exterior, chiefly with the food, and the majority give rise to no symptoms of disease provided proper cleanliness be observed. That many propagate and flourish in different parts of the tube is certain, and some appear to take a definite share in converting the food to a diffusible state, especially in the intestines, and to that extent are true digestive agents. The ferments which set up the lactic-acid change in the stomach are to be considered as normal, whilst those which develop butyric acid are clearly abnormal. The true pathogenic organisms, such as those producing tubercle, typhoid fever, diphtheria, and cholera, develop as they may find their surroundings suitable; but it is also probable that some forms of gastro-intestinal disturbance, such as summer diarrhœa of infants, are due to the activities of bacteria, which produce toxic substances—ptomaines—in the course of putrefactive changes set up by them in the intestinal contents.

A few species of Protozoa have been met with in the intestines, such as Amœba coli, Paramæcium coli, Cercomonas intestinalis, and Psorospermiæ. The other and larger parasites belong to the flat or round worms, and include the various species of Tænia and Bothriocephalus among the former, Ascaris lumbricoides, Oxyuris vermicularis, Trichocephalus dispar, and Ankylostoma duodenale among the latter. *See* ENTOZOA.

Gases.—The gases normally occurring in the stomach or intestines, whether they be swallowed with the food or formed during fermentation in the canal, are often much increased in amount, especially carbonic acid, sulphuretted hydrogen, and marsh gas, the last named being inflammable, and occasionally eructated in considerable quantity.

W. H. ALLCHIN.

DILATATION (*dilato*, I enlarge).

ÆTIOLOGY.—Dilatation of any of the cavities, tubes, or orifices of the body may either result from increased pressure from within, or from diminution in the resisting power of the walls of the tubes or cavities. These two causes are frequently combined, and, indeed, the latter is often the result of a long continuance of the former. Increased pressure from within may be due either to increased secretion of the normal contents of the cavity, or to some other effusion into it. This is the usual cause of dilatation of the closed cavities of the body; we have examples in the ventricles of the brain, the pericardium, the synovial cavities, the bursæ, the follicles of the thyroid body in cystic goître, and the Graafian vesicles in some forms of ovarian dropsy. In the various tubes of the body, increased pressure from within may arise from obstruction, and the consequent accumulation behind the seat of obstruction of the substances which it is the function of the tubes to transmit.

VARIETIES AND CHARACTERS.—1. *Cystic dilatation.*—In tubes which begin by blind extremities the result of dilatation is generally the formation of a cyst, and this is the usual mode of origin of the large class of *retention-cysts*, or *cystic dilatation.* We have examples in the sebaceous cysts, in the cysts of mucous membranes, due to the ducts of the mucous glands becoming obstructed by the products of catarrhal inflammation, in cysts of the kidney formed by dilatations of the Malpighian capsules and uriniferous tubules, and in dilatations of the gall-bladder, and of the pelvis of the kidney.

2. *Uniform or cylindrical dilatation.*—In tubes not beginning by blind extremities, the effect of the obstruction is usually to produce a *uniform* or *cylindrical*, and not a cystic dilatation; though sometimes one part of the wall will yield, and so cause a diverticulum or sacculus. These uniform and cylindrical dilatations may occur in all the tubes of the body. They are met with in the œsophagus and all parts of the digestive canal, in the heart, veins, bladder, ureters, bile-ducts, &c. This form of dilatation may be attended either with thickening and hypertrophy, or with thinning and atrophy of the walls. Usually when the tubes are in the main muscular, hypertrophy occurs, from increased exercise of the muscular fibres in their efforts to overcome the obstruction; but when the walls are mainly fibrous or elastic, they generally become atrophied and thinned.

3. *Compensatory or collateral dilatation.* Another form of dilatation from increased internal pressure may be termed *compensatory* or *collateral* dilatation; it is produced by the tubes having to transmit an increased quantity of fluid in consequence of the obstruction of other channels. Besides the blood-vessels, we may meet with examples of compensatory dilatation in one ureter when the other is blocked, and in the bronchial tubes and other parts. Resembling this form in its mode of origin is the dilatation caused by tubes having to transmit substances of too large a calibre, as, for example, in the passage of calculi down the gall-duct and ureters.

4. *Dilatation from changes in the walls.* The last class of dilatations consists of those due to diminished power of resistance in the walls of the tubes or cavities. The most important examples of this class occur in the circulatory and respiratory systems: in the heart from fatty degeneration; in the arteries from atheromatous changes. In the respiratory organs it occurs both in the bronchial tubes and in the air-cells. Here, however, the loss of resisting power is itself usually caused by prolonged increased pressure from within; which in the air-cells, as their walls are elastic and not muscular, rapidly causes atrophy, and subsequent dilatation.

W. CAYLEY.

DILUENTS (*diluo*, I wash or dilute).

DEFINITION.—Remedies which increase the proportion of fluid in the blood.

ENUMERATION.—Water is the only real diluent. It is given for this purpose in various forms—soups, *tisanes*, barley water, toast and water, milk, lemonade, aërated waters, &c.—to quench thirst, and increase secretion.

Uses.—Diluents are employed to lessen thirst, as in fever and diabetes, and to remove the products of tissue-waste. As the thirst may depend upon local dryness of the throat, as well as upon general want of fluid in the system, the power of water to quench thirst may be greatly increased by adding to it a little vegetable or mineral acid, or some aromatic, such as lemon or orange peel, which will stimulate the flow of saliva, and thus tend to keep the mouth moist after the liquid itself has been swallowed. The thirst-quenching power of water is also aided by the addition of mucilaginous substances, such as oatmeal, or linseed tea, which, leaving a mucilaginous coat on the inside of the mouth and pharynx, retard evaporation, and thus lessen the dryness of the mucous membrane. The free use of water, and especially drinking hot water on rising in the morning, or on going to bed at night, and between meals, is useful in gout, chronic rheumatism, and biliary lithiasis, lessening or preventing the occurrence of acute attacks. T. Lauder Brunton.

DIPHTHERIA (διφθέρα, a skin).—Synon.: Fr. *Diphthérite*; *Diphthérie*; Ger. *Diphtheritis*; *Diphtherie*.

Definition.—An acute, specific, contagious and infectious, and often epidemic, general disease; accompanied by pyrexia and great weakness; having as its local manifestation inflammation of various mucous membranes, particularly those of the throat and larynx, and the formation upon them, or upon external wounds, of ulcers covered by a fibrinous false membrane; and often followed by paralysis of varied distribution.

History.—From the writings of the most ancient physicians, it is evident that the disease we know as diphtheria existed in the earliest ages, and then had main features differing little, if at all, from those with which it presents itself to us now. Hippocrates, Aretæus, Galen, Celsus, and Aëtius, have all left fragmentary accounts of a disease prevalent in their time, which serve for its identification with diphtheria. From the sixteenth century onwards, since which time medical observation has been more fully recorded, we have reliable descriptions of epidemic diphtheria occurring at times in various parts of Europe, which leave no doubt as to the nature of the disease, and show that essentially it had not changed for centuries. Bretonneau, in a work published in 1826, gave an account of his experience of the disease, beginning with an epidemic in Tours in 1818; and from this description dates the copious modern literature upon the subject. Bretonneau, too, gave the modern name to the disease, by calling it *diphthérite*, and later *diphthérie*, in allusion to the production of membranes or skins—a special character of the malady. The most severe outbreak of diphtheria which has occurred in England was that which attained its height about the year 1858. But while later epidemics may not have been so severe as this, their occurrence has become more frequent, and, as will be discussed in the section on Pathology, the disease is now endemic in our large towns. In the article upon Croup, the writer has given his reasons for believing that at least a large majority of cases classed under this head are really true diphtheria having its primary seat in the larynx. But membranous croup and diphtheria are even yet considered by some physicians as distinct diseases, and in former times this view was much more prevalent. Consequently, many of the outbreaks of 'croup' in Scotland and England must be considered as epidemics of diphtheria. It is noteworthy, too, that the recent returns of the Registrar-General show an increase in the number of cases of diphtheria and a decrease in those of croup, doubtless from the recognition of most cases of the latter disease as examples of laryngeal diphtheria.

Incubation.—After exposure to the poison of diphtheria a certain interval elapses before definite phenomena of the disease appear, whether these be of the nature of general symptoms or the beginnings of the local lesion. This period of incubation varies greatly. It is much shorter after direct inoculation than when the poison is taken into the system by other channels. When animals are inoculated with diphtheritic poison, signs of the disease may appear in about twelve hours, or may be delayed as long as three days. In the human subject such inoculation occasionally takes place, as when diphtheritic membrane comes in contact with an open wound in another patient, or when instruments which have been used for an operation upon a diphtheritic subject have not been thoroughly cleansed and disinfected before being used for other purposes. In such cases the period of incubation resembles that seen in the experiments upon animals, but may be prolonged to four days. When, however, the poison is received in other and more indirect ways, the incubation time is much more variable, and probably its ordinary limits are from two to eight days. Yet certainly the lower limit is frequently anticipated, for there is no reason to doubt the accuracy of many published cases, in which the disease began a few hours only after exposure to infection. Cases are on record, too, where the incubation seemed to have been much longer, but these are more doubtful. Not only may it be suggested that a second exposure had occurred, but it is likely that, where this can be disproved, the poison was not received into the body at the time of exposure, but was held by fomites until a period much nearer to the outbreak, when the patient was in a more favourable state to receive the disease.

A difficulty in determining the period of incubation is caused by the invasion of the disease being not infrequently insidious. During the incubation, while there may be no symptoms at all, there may be mere indefinite feelings of malaise, not to be distinguished from the early symptoms of invasion in a mild attack.

There is reason to believe that the more intense the poison, or the more liable the patient, the shorter is the period of incubation.

Symptoms.—*Invasion.*—According to the severity of the disease in its clinical aspects, three separate types of diphtheria may be distinguished—the benign, the ordinary, and the malignant. These are not natural orders, but relative terms. Numerous cases occur which throughout their course may be classified as belonging to one or other of these groups. Yet, on the other hand, instances are also numerous which show a transition from one to the other group, which, beginning, for example, after the benign type, afterwards show the most serious symptoms or sequelæ of the disease; or which, presenting only ordinary symptoms at the onset, rapidly assume the features of the malignant type.

1. It will be convenient to describe in the first place the symptoms of the disease as it is *ordinarily* met with.

In such cases, after a period of incubation, the patient, as a rule gradually, but often almost suddenly, feels ill. He has wandering aches and pains, disinclination for exertion, slight headache, chilliness, loss of appetite, nausea—and rarely even vomiting, thirst, and the general discomfort of a febrile condition. The temperature of the body is raised, but not to a great degree—in most cases, at the onset, to not more than 100° or 101° F. At this time, however, the local symptoms of the disease appear in the form of soreness and tenderness of the throat, and slight enlargement of the glands at the angles of the jaws. The fauces, tonsils, soft palate, and pharynx are swollen, and show a diffuse dusky redness. The pulse and the respiration are hurried, in accordance with the general febrile state. The urine presents the usual febrile condition.

The symptoms rapidly increase in severity. The bodily weakness becomes extreme, and anæmia soon presents itself. The glands, not only those at the angles of the jaws, but their lymphatic connexions also, become greatly swollen, painful, and tender; and their covering of skin may be reddened. The pulse is frequent, feeble, and of low arterial tension; the respirations are more hurried. The local disorder now becomes characteristic. The tonsils themselves assume a paler aspect, but are surrounded by the reddened mucous membrane. Soon a white haziness appears in patches on the tonsils, the soft palate, or the pharynx. While the swelling of the parts already mentioned greatly increases, the haziness becomes more pronounced, until in disseminated patches a distinct false membrane is seen, slightly raised from the surrounding parts, yellowish-white in colour, ragged in outline, and surrounded by a zone of congestion distinguishable even from the general redness of the neighbourhood. At first the membrane can be detached from the underlying parts; and when removed it leaves an intensely red surface behind. But very soon it becomes more adherent, and its removal is only attained by laceration of the mucous membrane and the exposure of a bleeding ulcerated surface, on which a new layer of false membrane is formed in a short time. The membrane spreads, and may cover the whole of the fauces and pharynx. When this occurs there is usually so much swelling of the parts that scarcely any opening of the fauces can be seen. Further, the aspect of the membrane changes. From being yellowish-white, thin, and delicate, it becomes thicker, of a brownish tint, firm and leathery in texture. The difference in colour is due to admixture with decomposed blood-pigment, the entanglement of atmospheric particles, and drying of the exudation. Signs of coryza are present, and from the nostrils a thin acrid discharge issues.

The tongue is dry, coated with a white or brownish fur, and red at the tip. Appetite is entirely lost, and as a rare symptom there may be vomiting. Swallowing is difficult and painful. The bowels are, as a rule, constipated. The temperature becomes higher, but does not attain the extreme degree seen in many other fevers. Its ordinary height is between 102° and 103° F. The examination of the chest at this time, provided the case is uncomplicated, reveals either nothing at all, or only the rhonchi and râles of bronchial congestion. The urine is still febrile, and in a large number of cases contains albumen. Slight delirium may occur, but is not a frequent symptom in the ordinary type.

When such cases tend to a favourable issue, the duration of the disease is variable. Even after such a moderately severe form as that just described, the symptoms may begin to decline at about the fourth day; the patches of false membrane, after separating, cease to re-form; and the patient rapidly resumes his ordinary health. Usually, however, both the general and the local symptoms are prolonged for a much longer period, say up to the twelfth or fourteenth day, when slow convalescence begins.

Such is a description of the form in which diphtheria ordinarily presents itself, without any of the numerous complications which may occur. Many of the symptoms, however, require a more detailed description, and this will be given below.

2. The *benign* form is so mild that a considerable number of patients pass through it with so little feeling of illness that they consider it unnecessary to consult a medical man at all. There can be no doubt that such ambulant cases are important factors in spreading the disease. The patient suffers from but slight malaise and weakness, with loss of appetite and slight fever. The urine is usually not albuminous. No complaint whatever may be made of soreness of throat; and for this reason the nature of the complaint is frequently overlooked, even by medical men. Generally, however, there is some soreness in swallowing, and a little enlargement of the glands at the angles of the jaws. On examination, a few white patches of false membrane, easily detached, will be seen on the tonsils, rarely on the soft palate or pharynx. Rarely, with only mild general symptoms, very extensive deposit may be seen in the throat. In a few days the patches disappear, either by being coughed out or by gradual dissolution; no more form; the symptoms, slight as they were, decline; and the patient rapidly resumes his usual health. During the whole period of the disease it is possible for the patient to walk about, and even attend to his usual duties. But this is very undesirable, not only because such cases are as capable of spreading infection as more severe ones, but because, however slight may be the condition at the onset, at any time more serious symptoms may arise, and in this, the benign, form there is no exemption from the most dangerous complications and sequelæ of the disease, such as spread of the membrane to the larynx, cardiac failure, and paralysis.

3. The *malignant* form of diphtheria is characterised by severity rather of the general symptoms than of the local lesions. Commonly, from the first the symptoms are severe, though the early features of the case may be those of the ordinary or even of the benign form. There is extreme prostration; the pulse is rapid, feeble, and of low tension; and the respirations are hurried and shallow. The skin is dry, pungent to the touch, and of a generally dusky hue. The tongue is dry and brown. Very soon the 'typhoid' state develops, and there may be sometimes a muttering delirium, though in most cases this is absent. A hæmorrhagic diathesis is a frequent phenomenon in this condition, and is shown by the occurrence of hæmorrhages from various mucous membranes, or beneath the conjunctiva, and by the appearance of a purpuric rash on the skin. The temperature may be highly febrile, or not unduly raised. The urine is albuminous. While the symptoms of the throat-lesion are not very evident, yet its signs are characteristic. The false membrane is soft, pultaceous, and very dark—sometimes black, in colour. It is often extensive; and the tissues around are sloughing or gangrenous. A foul smell comes from the putrifying mass at the back of the throat. In most cases, too, the false membrane has spread to the nose; and a sanious discharge, also of foul smell, issues from the nostrils, and by its irritation excoriates the skin around with which it comes into contact. The glands of the neck are always much enlarged and inflamed. Such a condition in most cases ends fatally in a short time.

This general description of the three types of diphtheria requires to be supplemented by a detailed account of some of the symptoms.

Formation and Spread of the False Membrane.—The presence of the false membrane is the characteristic feature of diphtheria, and that from which it derives its name. It is the special local manifestation of the disease. But, as will be clear from the descriptions given, in diphtheria we have to deal with general symptoms which, in point of severity, may have no relation to the extent of the local lesion. In the benign form we may sometimes find the general symptoms very slight, or practically absent, while a large quantity of membrane may be seen in the throat. In the malignant form we may have the most severe general symptoms when the local phenomena, severe it may be, are not so prominent as the signs of general disease. The question then arises whether we may occasionally meet with general symptoms of diphtheritic fever, not only without signs of any local lesion, but without the appearance of any false membrane, and with merely congestion and swelling of the fauces, having no specialised character. It is in the experience of clinicians that this occurs, but certainly very rarely. It is possible that, in the course of an epidemic of diphtheria, instances of the benign form may be met with without more local lesion than the early congestion described; yet in such cases a slight formation of false membrane may easily be overlooked. Because of the existence of such a condition, Virchow originally described a catarrhal form of diphtheria, in which no membrane at all was formed. But it is beyond doubt that the poison of diphtheria may act so powerfully upon the system as to, in extremely rare cases, kill the patient before the local lesion has time to develop. It is only such cases as these which can without fear of error be used for argument; but they have been recorded by such competent observers that it must be admitted that diphtheria may at times occur without any specialised local lesion.

In by far the majority of cases, however, false membrane does appear. Generally it occurs first on some part of the throat—either on the tonsils, soft palate, or the back of the pharynx. Usually, too, it is seen in one or more spots simultaneously on both sides, and most commonly on the tonsils. Yet, occasionally, at an early period but one side may be attacked, but soon, however, an affection of the opposite side follows. The membrane can, at quite its early appearance, be detached with but slight difficulty, leaving a very red or hæmorrhagic surface behind. But very soon its connexions to the subjacent parts become much firmer; it can be removed only by some force, and leaves behind a rough, bleeding, and ulcerated surface. In all but extremely slight cases, a new formation of membrane then occurs; and this may be repeated many times if the disease continues. The detachment of membrane also takes place naturally, not only at the termination of the case, but during its height, new membranes being again formed. In this way, the patient may expel from the mouth, usually by coughing, large quantities of the false membrane, in small or large shreds. Where the larynx and trachea are attacked, complete casts of these cavities may be thus expectorated; and in still more serious cases even moulds of the smaller bronchi are occasionally coughed up.

In the early stages, the membrane appears as a thin whitish deposit, which rapidly thickens. The colour, too, soon changes, passing through stages of grey, greyish-yellow, yellow, brown, and even black. Its consistence increases, becoming in most cases very firm, and resembling shreds of kid-leather. In the malignant form, the membrane becomes softened, and even pultaceous. Its colour then is still darker, and the membrane becomes mixed with blood or the products of its decomposition.

The isolated patches in which the membrane first appears soon spread and amalgamate, until the whole of the throat, as seen on opening the mouth, is entirely covered. But the affection spreads farther. One of the most dangerous complications of diphtheria, and also one of the most frequent, is the spread of the membrane to the larynx. This is more frequent in children; and, while dangerous in adults, is still more so in children, because of the greater ease with which it diminishes the lumen of the glottis. The signs by which the complication may be diagnosed are the following. The patient feels soreness in the larynx, and is greatly troubled by cough. The breathing becomes first wheezy, then stridulous, and always more hurried than before. The cough is harsh; the voice is hoarse and husky, and finally lost. The patient, if a child, clutches at the throat as if to remove an obstruction. Soon the narrowing of the larynx interferes greatly with the entrance of air into the lungs. All the extraordinary muscles of inspiration are brought into action. The lower ribs cease to move outwards, and later on are depressed at each inspiration. The supra-clavicular spaces are similarly depressed. These signs are more obvious in children: in very young subjects, and especially in those affected by rickets, the whole chest-wall may be depressed as each breath is drawn. Signs of cyanosis may now be observed in blueness of the lips and cheeks; but more commonly the face is pallid. The pulse is very rapid. The temperature is no more raised than it was before, and may indeed be only slightly above the normal. The forehead, and even the whole body, becomes covered with a cold clammy sweat. If unrelieved by operation, this condition soon ends in death, occasionally preceded, in young subjects, by convulsions.

The opinions of observers of great experience vary as to the period of the disease at which extension of membrane from the pharynx to the trachea is most likely to occur. Sir William Jenner stated that he had never known this complication commence after the expiration of the first week of the disease. Oertel, on the other hand, speaks of its occurrence as late as the thirteenth day; and Henoch saw it begin fourteen days after the commencement of the primary disease. Sir William Jenner's statement, however, is correct for the majority of cases; and we may place the usual time of appearance of secondary laryngeal symptoms at three to six days after the onset of the diphtheria. It is rather in the mild and in the ordinary forms than in the malignant that this complication may be looked for. Yet its appearance is a sign of extreme danger; most of the deaths from diphtheria are due to this cause. Sir William Jenner again states that he had seen death occur twelve hours after the onset of laryngeal symptoms, and had never known it delayed more than five days; and his experience agreed with that of Bretonneau.

The membrane frequently spreads to the nares also. This is almost invariably the case in the malignant, but occurs, too, in the ordinary form. The symptoms of the complication are snoring or snuffling respiration, and the discharge of an acrid fluid from the nostrils, which excoriates the surrounding skin. The excoriations may in their turn become covered by diphtheritic membrane when the disease is severe. Shreds of membrane, too, may be discharged from the nostrils. Epistaxis is of frequent occurrence. Sometimes, as stated in the account of malignant diphtheria, this is due to the general tendency to hæmorrhage found in septic diseases, but it is also a sign of invasion of the nasal mucous membrane. From the nose the lacrymal ducts, and even the conjunctivæ, may be infected, leading occasionally to destruction of the eyeball.

Spreading from the throat, the membranous formation easily reaches the upper pharynx, and by way of this proceeds to the middle ear. Great pain and sense of distension are thereby produced, and severe *otitis media* with destruction of the parts, or even *otitis interna* and *externa*, and necrosis of the bone, may result.

The œsophagus, too, may be affected in the whole of its length, and even the stomach and intestines, as will be mentioned in the pathological description.

Sometimes false membrane may appear in various parts of the mouth, probably by the infection of abrasions of surface.

In most cases, as above described, the membrane makes its first appearance in the throat. Yet numerous cases are now on record in which it has first been seen elsewhere.

The primary laryngeal form of the disease is well recognised, and has been known by the name of Diphtheritic Croup. The general symptoms of the disease are then the same as in the ordinary form, but signs of the trouble in the larynx occur early and before any affection of the pharynx can be detected. With the laryngoscope, if the patient will allow of it being used, false membrane, having the ordinary appearance, can be seen covering the posterior surface of the epiglottis, the whole of the interior of the larynx, and even of the trachea. The affection may remain localised in the larynx until death, or may extend thence to the pharynx and other parts.

A primary nasal form is rare, but sometimes met with. Here the coryzal symptoms and the muco-purulent or sanious discharge from the nostrils occur early in the disease; and, when the affection is advanced, false membrane may be seen near the anterior nares. From the posterior nares the lesion may spread to the pharynx, as in the laryngeal form. Such cases are often overlooked in their early stages, because of the obscure position of the characteristic membrane. They are generally severe in character.

External wounds or abrasions may be secondarily infected and covered by false membrane in the course of the ordinary disease. But, on the other hand, there happen cases in which not only has the first local appearance of the disease been seen in an external wound, but the inoculation of such a wound has been the means of infecting the general system. Thus diphtheria has originated from the use of an infected instrument in the operation of circumcision, diphtheritic membrane first developing on the wound. Dr. Hill has recently described cases in which the primary lesion was on the perinæum. Dr. Braxton Hicks and others have also described cases where the first appearance of the false membrane was on some part of the female genital organs, doubtless as the result of accidental inoculation.

Affection of the Glands.—The glands beneath the jaw are swollen and tender in all but very exceptional cases of diphtheria. In most they are so large as to be easily seen; in nearly all they can be felt. But in by far the larger majority of cases the swelling of the glands is a very marked feature. In severe cases, too, it is not only the glands beneath the jaw, but also all those of the neck, on both sides, though the affection of one side may predominate. The skin covering them is swollen, reddened, and œdematous. Sometimes, too, the tissue lying between the glands is greatly inflamed; and in a few cases a brawny hardness, extending from the jaw to the clavicle and involving apparently all the tissues of the neck, an *angina Ludovici*, has been observed. Rarely, the glandular inflammation may proceed to suppuration, causing a large and formidable abscess. The affection of the glands and surrounding tissue is more marked in the severe, and especially in the malignant forms.

Condition of the Urine.—The urine in diphtheria resembles in its general characters that of other febrile diseases, though the features are less marked than in other affections. It is diminished in quantity, high-coloured, and deposits urates and uric acid. Sometimes, too, it may appear but little changed. But a special feature of the disease is the occurrence of albuminuria, as first pointed out by Dr. Wade of Birmingham, in the *Midland Quarterly Journal of Medicine*, 1857. This appearance is very frequent, and is found, according to statistics, in one-half or even two-thirds of the total number of cases. The amount of albumen may be only slight, or, on the other hand, very great; and it may disappear from day to day, to again return. With it may be found in the urine hyaline or epithelial casts, but only very rarely blood, and the occurrence of albuminuria is in only extremely exceptional cases accompanied by anasarca or followed by any uræmic symptoms. Whether albuminuria is present or not, the daily excretion of urea is normal, or increased. It differs markedly from the albuminuria of scarlet fever, in making its appearance nearly always during the acute course of the disease: very seldom at the time of convalescence. In most cases it appears on the third or fourth day. Sanné, amongst others, has made extended investigations into this complication. He examined, in reference to albuminuria, 224 cases; and found that it appeared on the first day in three, on the second day in ten, on the third and also on the fourth day in thirty, on the fifth day in twenty-two. After the fifteenth day albuminuria occurred only once for the first time. As a general rule, the greater the quantity of albumen in the urine, and the earlier its appearance, the more severe is the case; but the mere presence of albuminuria does not affect the prognosis of the diphtheria. In most cases the albumen disappears during convalescence; though, as the writer can confirm, it may continue in the urine for months in moderate amount, and unaccompanied by other symptoms, beyond slight weakness and anæmia. On the other hand, the writer has reason to believe that in exceptional cases chronic nephritis may have its origin in an attack of diphtheria.

Temperature.—The temperature in diphtheria has no definite course. It rises suddenly early in the disease, and as a rule continues, with morning remissions, until the beginning of convalescence, when it declines gradually. The average temperature at the height of the attack is from 102° to 103°, and very rarely does it exceed 104° F. It may become raised above the average limit by the advent of complications, such as broncho-pneumonia or suppuration in the neck; but, with these exceptions, the height of the temperature is no certain guide to the severity of the general disease or to the extent of the local lesion. In cases of prolonged diphtheria, such as will be noted below, after remissions or even intermissions of the raised temperature, renewed attacks of pyrexia are met with, generally associated with increase of the general symptoms.

The Pulse and Heart.—The pulse in diphtheria is throughout of an asthenic character, short, ill-sustained, and of low tension. In the majority of cases it is frequent, above the degree to be expected from the fever. Dr. Sidney Phillips, in the *British Medical Journal*, 1890, i. p. 960, has analysed 100 cases of diphtheria with reference to the states of the circulation which may occur. In three per cent. of his cases the pulse was unduly slow, and these instances were characterised by vomiting and by a fatal issue. He concludes that a very rapid pulse, also a very dangerous symptom, may occur without any other phenomenon, but may be accompanied by vomiting and extreme drowsiness. Irregularity both in the rhythm and the force of the pulse is not uncommon and not unfavourable. The heart-sounds are feeble, and the first sound short. Disturbances of the intervals between the sounds are, in the opinion of the writer, of great importance. A rapid sequence of the second sound upon the first, but especially 'spacing' of the sounds, as heard at the apex of the heart—that is, an equalling of the intervals between the first and second, and the second and succeeding first sound respectively—are of most serious import, and indicate a liability to sudden cardiac failure, the most dangerous complication of diphtheria. These alterations in the sounds of the heart may be detected both at the height of the fever and during convalescence, and are equally important at either time. Acute dilatation of the heart, usually of the right ventricle, sometimes of the left, is not infrequent in diphtheria. It may be accompanied by a systolic murmur, heard at the apex or over the area of the pulmonary artery. But such a murmur is not due to endocarditis. Bouchard and Labadie-Lagrave have maintained that endocarditis is a frequent complication of diphtheria, but their opinion has been supported by no other observers. The cardiac dilatation does not occasion dropsy, as it does in most other conditions, but the weakness of the heart's impulse is the cause of the thrombosis of the large veins which sometimes, though rarely, occurs.

Rash.—A certain degree of efflorescence on the skin is not uncommon in unmixed cases of diphtheria, and especially in the severe variety. It is usually seen about the neck and the upper part of the chest. It is a diffuse redness, not punctate, and not papular in the slightest degree. This is not a specific rash, and must be carefully distinguished from that of scarlet fever. To the writer, it has appeared to be somewhat darker in colour than the rash of scarlet fever. In the malignant forms purpuric spots of different sizes may be observed, scattered over the whole surface of the body in great numbers.

COMPLICATIONS AND SEQUELÆ.—Many of the complications have already been described in the foregoing account of the disorder, and such will be here only enumerated.

1. Extension of the false membrane to the larynx and lower air-passages, to the nose, ear, and eye.
2. Formation of false membrane on external wounds and abrasions.
3. Extensive ulceration, and even gangrene, of the tissues of the throat. Henoch mentions perforation of the palate as an occasional result.
4. Great inflammation in the neck, and rarely suppuration.
5. Albuminuria.
6. Suppression of urine, and uræmia. This has been described by Oertel and by a few other observers, but its occurrence is contrary to general experience; and, as Dr. Hilton Fagge has remarked, it is probable that scarlet fever has been overlooked in such cases.
7. Dilatation of the heart.
8. Cardiac failure, syncope, and sudden death. This complication is the most dangerous which can occur in diphtheria, and may come on at any period of the disease, and even during convalescence. It is preceded usually by a very frequent, sometimes by a slow, pulse, but its special warning is an alteration in the sounds of the heart, as described above. The cardiac failure may in some case sshow itself by a gradual failure of the circulation, but usually by sudden syncope, which is nearly always fatal. The most distressing cases in which this occurs are those where the patient, some time after the decline of pyrexia, is in full convalescence, or even in apparently good health, yet suddenly faints and almost instantly dies. No patient is absolutely safe from this fatal

mishap until at least six weeks after the apparent end of the disease.

9. Hæmorrhages. These may occur, not only from the ulcerated mucous membranes, but also from any mucous surface. They may be so copious as to seriously weaken the patient.

10. Thrombosis of veins.

11. Affections of the bronchi and lungs. General bronchitis may be met with in diphtheria before the larynx is attacked, and may be followed by extensive broncho-pneumonia. Both these complications are, however, more frequent when the air-passages become involved in the special diphtheritic inflammation. Collapse of lung, emphysema, and hæmorrhage into the tissues of the lung are also met with at times. Their special symptoms are added to those of the original complaint, and need not be here detailed.

12. Paralysis. Though paralysis may follow other febrile disorders, yet it is so frequently an association of diphtheria as to form a characteristic feature of the disease. The paralysis, as statistics show, varies in its frequency in different epidemics. Cadet de Gassicourt found that it occurred in 128 cases out of 937. Dr. Gowers states that its frequency has been reported as from 8 to 66 per cent., and that probably one-fourth of the cases which do not die from the primary disease suffer from paralysis. The paralysis as a rule appears about two or three weeks after the decline of the pyrexia, but it may occur during the height of the disease, even as early as the second day (Sanné), and it may be delayed until the fourth or fifth week from the attack. As Landouzy has shown, the older the patient the more liable he is to this sequela. It is more common after slight cases of diphtheria, but its onset is earlier in the severe forms.

The first part to be affected by the paralysis is the soft palate. The patient then speaks with a nasal voice, and is unable to swallow fluids, since the immobile palate no longer closes the entrance to the posterior nares, and so fluids regurgitate through the nose. The palate hangs motionless during respiration and phonation, and is insensitive to touch. Occasionally, and for a time only, one side of the palate remains unaffected, and then the uvula is drawn to one side and the curves of the palatal edges are unequal. In rare cases the inability to swallow extends to solids also, from paralysis of the muscles of the pharynx.

The next most common paralysis is that of the eye. The most obvious effect of this paralysis, and that which most readily attracts the attention of the patient's friends, is an external strabismus from paralysis of the internal rectus muscle. But this is not the most common result. More frequently we meet with a paralysis of the ciliary muscle, usually in both eyes, which has as its effect a loss of the power of accommodation. Unless the patient has previously been myopic, he is now unable to adjust his eye for near objects, as, for instance, in the act of reading, while vision for distant objects remains unaltered. The pupil, too, is sluggish in contracting to light. Other muscles of the eyeball may suffer, so that various forms of squint are met with, and sometimes ptosis; while, in exceptional cases, one or even both eyes have become absolutely motionless from paralysis of all their muscles. Concentric contraction of the fields of vision has been described.

Other organs of sense suffer but rarely, but Dr. Gowers states that he has met with loss of taste, and loss of smell without loss of taste.

The limbs next suffer from the paralysis, and usually the lower before the upper limbs. The paralysis is generally preceded by tingling feelings, sense of 'pins and needles,' or actual pain, in the parts about to be attacked. Then gradually and slowly the paralysis sets in. It is but rarely complete, but always sufficient to render the muscles practically useless. The muscles are flaccid and soon begin to atrophy. The knee-jerks are lost; but this phenomenon may be met with, as Dr. Buzzard and Dr. Hadden have shown, early in the primary disease; and Dr. Angel Money has found that there may be a previous exaggeration of the knee-jerks. All reflexes are abolished. The affected muscles after a time cannot be stimulated to contraction by the faradic current, though they still retain their reaction to galvanism. Together with the paralysis, and sometimes without it, a certain amount of ataxy is not infrequently seen, most obvious in the legs, though also sometimes found in the arms.

Sensation, in one or all of its varieties, is usually lost to a greater or less extent, but not always in proportion to the loss of muscular power. The distribution of the anæsthesia varies. It may be spread over the whole limb, or appear only in patches. It is usually most marked in the fingers and toes.

These affections of the limbs are usually bilateral, though not necessarily equal on the two sides.

There is scarcely a part of the body which may not be affected by the paralysis, but other parts than those mentioned are comparatively rarely attacked, and only in severe cases. The intercostal muscles may be paralysed, and less frequently the diaphragm, so that respiration becomes difficult or even impossible. The head falls forward, if the patient is in the upright position, from weakness of the neck muscles. The muscles of the larynx are sometimes attacked. The muscles attached to the epiglottis cease to close the orifice of the larynx, and food may then reach the air-passages. More rarely, the muscles of the vocal cords themselves are weakened or paralysed, and the voice is altered in quality or entirely lost. The bladder and rectum may be affected in severe cases, but generally they are unaffected. Amongst the muscles most rarely attacked are those of the face and tongue.

In the most severe cases it is possible for nearly all the muscles above-mentioned to be paralysed at the same time, so that the patient lies in bed utterly helpless. This condition, however, is extremely rare. More usually, the paralysis recovers in one part while it progresses in another, and as a rule does not recur in a part it has already left. A patient the subject of diphtheritic paralysis is in most danger of heart-failure, for this complication, while liable to set in during the height of the primary disorder, is specially prone to occur during paralysis. The nutrition of the body may fail from the inability to swallow food; and from food entering the larynx pneumonia may arise. In very rare cases death ensues from paralysis of the respiratory muscles. Yet all these dangers are comparatively rare; and usually the paralysis, however severe, after a time gradually and entirely disappears. According to Dr. Gowers, the average duration of the paralysis is from six to eight weeks in cases that recover, but it remains longest in the limbs, and may there last for as long as four or six months.

TERMINATIONS. — (1) *Resolution.* — When the attack ends favourably the fever declines by lysis; the membranes soften, separate, and do not reappear; the patient gradually recovers strength, and resumes his ordinary health. The duration of ordinary cases is about ten to fourteen days, but the attack may be prolonged by recrudescences to a much longer period.

(2) *Death.*—Death occurs in diphtheria (*a*) by gradual asthenia from mal-nutrition; (*b*) by rapid asthenia from excessive effect of the poison; (*c*) by cardiac failure; (*d*) by asphyxia from spread of the membrane to the larynx, or paralysis of the respiratory muscles; or (*e*) by any of the complications enumerated above.

ANATOMICAL CHARACTERS.—*False membrane.*—The naked-eye appearances of the false membrane have already been sufficiently described. When a section of the mucous membrane covered by the exudation is examined under the microscope, the false membrane is seen to consist of either threads or shapeless masses of fibrin, in which are embedded leucocytes, more or less degenerated, red blood-corpuscles, and shrivelled cell-nuclei. In the deeper layers of the false membrane the outlines of epithelial cells can be seen, showing their bodies swollen into a hyaline or granular mass; the nuclei are not visible; and these cells no longer easily take the ordinary stains. No definite line of demarcation between the false membrane and the true mucous membrane can be seen: the one joins the other gradually and irregularly. The mucous membrane shows swelling and proliferation of its epithelial cells, and is infiltrated with leucocytes. Its blood-vessels are congested, sometimes thrombosed, and hæmorrhages are seen in the tissue. Numerous micro-organisms, of which a fuller account will be given in the next section, are found, not only in the false membrane, but in the tissue of the mucous membrane, its veins and lymphatics. In the later stages, further degenerative changes are found in the false membrane. It is then much more granular, as seen under the microscope; contains numbers of fatty globules and crystals of fatty acids and cholesterin; and swarms with the micro-organisms of putrescence. The false membrane consists in part of an exudation of fibrin elements, but mainly of the products of coagulative necrosis of the epithelial cells. Hence its close connexion with the mucous membrane.

Glands.—The swollen glands are, on section, soft, red, and pulpy, resembling splenic tissue. They show the changes of acute lymphadenitis, and contain micrococci. The lymphatics leading to them are also enlarged and inflamed, and contain micro-organisms. Spots of suppuration are occasionally, but rarely, found in the glands.

Respiratory organs.—The larynx, trachea, and bronchi may be covered by false membrane. Its characters here are slightly different from those found in the pharynx. It is thinner, somewhat softer, and more easily separated from its attachments. These characters are due to no peculiarity in the membrane itself, but probably to the thinner layer of epithelium from which in this situation it takes its rise. The membrane may be prolonged into the smallest bronchi which can be followed out. More commonly, however, after proceeding down the trachea a little way, it becomes soft, loose, and at last continuous with a thick purulent or muco-purulent exudation, which covers the mucous membrane of the bronchi, but is not attached to it. The lungs may be congested, or show the changes of broncho-pneumonia or of pulmonary apoplexy. Very frequently, too, emphysema or insufflation of the lungs is seen in patches.

The mediastinal glands may be swollen, and resemble in appearance those of the neck.

Circulatory organs.—The cavities of the heart, especially those of the right side, contain *ante-mortem* clots firmly adherent to the endocardium. Endocarditis is not found. The muscular tissue of the heart is nearly always softened, and may sometimes show carditis or fatty degeneration. In a few cases, as the writer has found, colonies of micro-organisms may be seen embedded in the muscular tissue. Frequently, and especially if there has been difficulty of respiration, small punctiform hæmorrhages may be observed beneath the visceral layers of the pericardium and pleuræ. In the malignant form, the blood after death is found to be of a dark chocolate colour, and very fluid.

Pleurisy and pericarditis are only rarely seen.

Digestive organs.—The false membrane may be found extending down the whole of the œsophagus, and may affect the mucous membrane of the stomach, and even that of the intestines. The Peyer's patches and the lymphatic nodules of the intestines are swollen, and may sometimes show ulcerations. The liver is congested. The spleen is enlarged, but not excessively so, and on section is found to be softened and pulpy.

Urinary organs.—The kidneys, in all cases, show the change of their epithelial cells called cloudy degeneration. When albuminuria has been present during life, the kidneys present the usual appearances of acute parenchymatous nephritis. The organs are swollen, pale in colour, and soft on section. The cortical portion is unduly enlarged, and of a yellowish-white colour. On microscopic examination, the cells of the convoluted tubes, and also those of the glomerular and capsular epithelium are seen to be swollen, and often proliferated. The changes only differ from those of scarlatinal nephritis in being of a less intense degree, less hæmorrhagic, and in being present often in scattered patches rather than diffused over the whole organ. Sanné asserted that in most cases only one kidney was affected, and thus explained the absence of uræmia and dropsical symptoms. This assertion, however, is not confirmed by the observations of the writer or of others.

Muscles and joints.—The external muscles, and sometimes those of the heart, may show the waxy degeneration of Zenker. In rare cases the joints may be found inflamed.

Nervous system.—Associated with the paralysis, changes have been found in the spinal cord and the peripheric nerves. Degeneration and atrophy of the anterior cornua of the spinal cord have been observed by Drs. Abercrombie, Percy Kidd, Mott, and others, while extensive degeneration of the peripheric nerves was first clearly and fully demonstrated by Déjerine, an observation since confirmed by many others. The degeneration of the nerves is seldom found in the whole of their extent, and may attack the portions near the spinal cord or those more remote. The change corresponds in its distribution and degree with the region and severity of the paralysis. The affected muscles show granular and fatty degeneration.

Pathology.—The older discussions as to whether diphtheria was from the first a general disease with a local manifestation in the throat—comparable, indeed, to enteric fever—need now be merely mentioned. It is at the present time beyond doubt that the primary local lesion in diphtheria is due to changes at the site of inoculation, and that from this are absorbed the poisonous matters which give rise to the general symptoms. In the false membrane there are found swarms of micro-organisms, most of which, however, are either entrapped by the fibrinous exudation or are the accompaniment of the putrefactive changes going on in the membrane and in its vicinity. Such adventitious organisms are found only in the superficial layers of the false membrane, except in the malignant form, where they may be met with in the deeper tissues, in the thrombosed vessels, and in the lymphatics and glands. In 1883 Klebs discovered a bacillus in the deeper layer of the membrane, which he believed to be the specific organism of the disease. Its relation to the disease was afterwards fully worked out by Löffler in 1884, who showed that its cultivations, when injected into guinea-pigs, produce changes at the site of the inoculation identical with those found in the throat of man, and afterwards the general symptoms of the human disease. Further progress in this direction has been made by Dr. Klein, who, in the *Report of the Medical Officer to the Local Government Board* for 1889, has shown that the bacilli described by Klebs and Löffler are of two different kinds, which he has separated. Both are found in all parts of the diphtheritic membrane, but are free from other organisms in the deeper layers. One of these bacilli, styled by Dr. Klein the pseudo-diphtheritic bacillus, is not constant in its presence, and can only be cultivated at a raised temperature. The other, asserted by Dr. Klein to be the true bacillus of the disease, grows on gelatine at the ordinary temperature of a room, and has other technical differences which serve for its separation. It grows readily in milk. These bacilli are only found at the site of the local manifestation of the diphtheria and in the neighbouring glands; never, except in cows, in the blood or deeper tissues; so that if they are the cause of the disease, the general symptoms must be due to poisoning by some chemical product of the growth of the bacillus. This poison, or what is believed to be such a poison, has been separated from growths of the bacillus by Roux and Yersin, Fränkel and Brieger, and others; and by means of its inoculation they were able to produce the general symptoms of the disease. The theory, then, which at present best explains the pathology of the disease, is that we have an infection of the throat or of a superficial wound by the diphtheria bacillus, which there takes root, and by the products of its growth infects the whole organism. How its poison produces the general symptoms of the disease we have at present no theories to explain. Recently, experiments have been made by Behring and Kitasato, Brieger and Fränkel, and Löffler, as to the possibility of weakening the action of the bacillus by various methods, and so conferring immunity against its further action; but, so far, no results have been obtained which are of use in human therapeutics.

The pathology of the cardiac failure so often met with is also obscure. It may be due to actual poisoning of the heart-muscle by the virus of the disease; and this may be the process at work when this accident occurs in the early stages of the fever. The stoppage of heart, though in regard to its symptoms a sudden phenomenon, may be really due to a gradually accumulating weakness. Dr. Sidney Phillips has shown that from cardiac weakness there may be a gradual filling up of the right ventricle by thrombus, accompanied by symptoms scarcely appreciable in the midst of the general febrile disturbance. Sudden death, however, will occur when in the right ventricle and pulmonary artery there is not left sufficient room for the circulation to be carried on. In the later stages, the cardiac failure is probably due to changes in the pneumogastric nerve or its central connexions—changes, however, which as yet have not been demonstrated.

The changes in the nerves have been found to be parenchymatous in nature, except in one case reported by Meyer, where nodular enlargements were seen, due to infiltration of the nerve-sheath. Though the changes are generally described as due to 'parenchymatous neuritis,' there is no proof of their being inflammatory, and the appearances observed are degenerative. In some cases of post-diphtheritic paralysis there is great difficulty in tracing the affection to an antecedent sore-throat, and the question has arisen whether the sequelæ may occur without any specific local lesion. That there may be a non-membranous primary diphtheria has been argued above, and this may be followed by paralysis. A remarkable series of cases illustrating the difficulties in which the physician may be involved, is recorded by Boissarie in the *Gazette Hebdomadaire*, 1881, p. 310, amongst which, during an epidemic, the first symptoms observed were those of paralysis in many cases, in some *followed* by angina, whereas, in succeeding cases, the disease had its accustomed course.

The albuminuria may be due to several causes. In many cases, of course, the organic changes in the kidney sufficiently account for the symptom. But in other cases, and especially in those where it is an early symptom of the disease and quickly disappears, it would appear to the writer to be due to a disorder of the circulation dependent upon the weakness of the heart's action. This may be combined with organic change, as it is in all cases of Bright's disease, but the essential factor in the production of the albuminuria is the disorder of circulation.

Mode of access of the poison to the system.— Diphtheria is eminently a contagious disorder. A large number of the cases can be traced to actual contact with diphtheritic membrane or the secretions therefrom. Thus, surgeons who, after performing tracheotomy, have sucked out the secretion which blocked the tube, have very frequently contracted the disease, as have also relations who have kissed a patient. The cases alluded to earlier in this article, in which wounds have been inoculated by diphtheritic poison, are also demonstrative of this fact.

But diphtheria is also infectious, as is shown by its spread from one district and from one country to another. It occurs most frequently in epidemics, and yet in the present day it is so endemic in our large towns that they are never free from it. It forms a large item in the regular annual bills of mortality.

Its spread seems to have no connexion with the water-supply. But instances are now numerous in which outbreaks of diphtheria have been associated with a particular supply of milk. Here we may not only have to deal with a mere transference of the poison from man to man, milk being merely the vehicle, as is the case with scarlet fever, but the question also arises whether there may be a disease in cows which is identical in pathology with human diphtheria and capable of producing the latter. Dr. Klein's recent observations are of great importance in this connexion. During epidemics, it had been noted in a few instances that the cows, from which the infected milk had been derived, had had chaps or sores on the teats. Dr. Klein inoculated healthy cows with cultivations of his diphtheria bacillus, and in consequence of this observed not only a local affection at the point of inoculation, and general symptoms too, but also an eruption on the teats and udders. He also succeeded in obtaining cultivations of his diphtheria bacillus from the milk of such a cow, and, further, an outbreak of diphtheria amongst the cats of the Brown Institution was traceable to two cats who had been accidentally fed on the milk of the infected cows. These observations are extremely suggestive, and, if confirmed, will throw great light upon the ætiology of diphtheria.

Medical men have, at different times, attributed outbreaks of diphtheria in man to infection or spread of infection from cats and other domestic animals, but no distinct proof of such a method of attack has hitherto been published. Nevertheless, Dr. Klein has shown that cats spontaneously suffer from a disease which is associated with the presence of his diphtheria bacillus, and also that the same disease is produced in them by inoculation on the cornea with poison derived from human diphtheria. Dr. Klein is of opinion that in cats the primary seat of infection, in idiopathic cases, is the lungs.

Ætiology.—The exciting cause of diphtheria is doubtless an organised poison, and it may be accepted, provisionally at least, that it is the diphtheria bacillus described by Dr. Klein. The means, however, by which this germ obtains access to the body, and is allowed to work its ill effects therein, are of all importance, and constitute the predisposing causes of the disease. These may shortly be discussed as follows:—

1. *Age.*—The statistics of the incidence of diphtheria at various ages have been collated by Dr. Thorne Thorne in his 'Milroy Lectures' for 1891. The greatest number of cases, he remarks, occur between the ages of two and five years, or, more widely stated, between three and twelve years, and this excess may possibly be due to the greater exposure to infection during this period from the aggregation of children in schools.

2. *Sex.*—The disease is more frequent in females, possibly, according to Dr. Thorne, because of the greater danger of infection they undergo in nursing the sick.

3. *Heredity.*—There undoubtedly are some families in whom a more than usual number of cases of diphtheria occur, and this probably is due to an inherited weakness, rendering the members unduly receptive of the poison.

4. *Season.*—Dr. Tatham, when medical officer of health for Salford, published in his reports most careful statistics as to the number of cases occurring in that locality, where diphtheria is especially rife, at various times of the year. Dr. Tatham has kindly furnished the writer with the table which follows, in which it is clearly shown that an increase in the number of cases of diphtheria begins in the third quarter of the year; the number attains its maximum in the fourth quarter, and, while declining in the first quarter, nevertheless is still in excess of the number occurring in the second quarter.

Borough of Salford.

Reported Attacks of Diphtheria in the several Quarters of the Seven Years 1883–1889. (*Dr. Tatham.*)

—	First quarters (Jan., Feb., March)	Second quarters (April, May, June)	Third quarters (July, Aug., Sept.)	Fourth quarters (Oct., Nov., Dec.)
Reported cases	270	233	290	431
Proportion to whole . .	22%	19%	24%	35%
Deaths amongst the above reported cases.	79	62	58	125
Case fatality	29%	27%	20%	29%

The table also shows (see percentage of deaths) that in the third quarter of the year the milder cases occur, and the greatest number of deaths in the fourth and first quarters, the excess in the first quarter being probably due to a legacy of severe cases left from the preceding quarter.

5. *Rank.*—The disease is more prevalent among the poor, probably because overcrowding increases facilities for contagion and infection.

6. *Hygienic conditions.*—There is no doubt that exposure to sewage emanations is a fruitful source of diphtheria. How this comes about is not precisely certain: we do not yet know that the diphtheria-germ grows in sewage, or is given off in sewage-gas. The cases reported by Dr. Hill of perineal diphtheria, already mentioned, tend to show that this might be the mode of infection. Dr. Thorne, however, is of opinion that sewage-gas produces a morbid condition of the fauces which renders the patient more liable to the reception of the diphtheria poison. He makes the very apposite remark that diphtheria has greatly increased of late years, and especially in towns, whilst improvement in hygienic surroundings, and especially in the disposal of sewage, has received much more attention, and in consequence of this, diseases undoubtedly due to sewage infection, such as enteric fever, have greatly diminished. This is a fact which militates against the view that diphtheria is connected with poisoning by sewage, but the statistics of the association between the two are very positive.

In former years, diphtheria was more common in country districts than in towns, or, to speak more accurately, in the sparsely populated than in the densely populated parts. In recent times, as shown by Dr. Longstaff in the *Report of the Medical Officer to the Local Government Board* for 1888, this relation has been reversed, and now diphtheria is the more common in thickly populated districts. The statistics also show that the geological conditions have but little effect on the incidence of the disease. Dr. Thorne, however, asserts that this is only true as regards the structure of the soil itself, in relation to drainage. A clay soil may be rendered immune from diphtheria by the possibility of free drainage. But where moisture is accumulated, and also allowed to remain stagnant, there diphtheria is rife.

7. *Influence of other diseases.*—The way for the diphtheria poison may be prepared by other diseases, such as tonsillitis, rendering the fauces a vulnerable point, or by diseases which weaken the system and so diminish its power of resistance. Probably the puerperal state should be associated with the latter group of conditions.

In most works on diphtheria hitherto published, it has been customary to speak of a primary and of a secondary form of the disease. The former is that ordinarily met with. By the latter is understood the occurrence of diphtheritic lesions and symptoms after various other diseases, amongst which the principal are scarlet fever and measles. It must be remembered in connexion with this subject, that the mere appearance of a false membrane is not a proof of the existence of diphtheria. The same process, coagulative necrosis, which is the main factor in producing the diphtheritic membrane, also takes place on mucous surfaces as the result of many other intense inflammations. Thus, in scarlet fever, the occurrence of a false membrane on the fauces may be due only to a specially irritative effect of the scarlatinal poison. Nevertheless, cases not infrequently occur—and the writer has had many opportunities of examining such—where, together with positive symptoms of scarlatina, large quantities of diphtheritic membrane have formed in the throat, and have even extended to the larynx, and where also after a time the characteristic paralyses of diphtheria have shown themselves. Such cases are specially prone to occur when epidemics of scarlet fever and diphtheria coetaneously exist, and there is reasonable ground for believing that they are due to a dual infection by the poison of both diseases. In attacks of 'scarlatinal diphtheria' a special streptococcus has been found by several observers, but the evidence of its identity is still incomplete.

8. *Previous attacks.*—One attack of diphtheria confers no immunity upon its subject. Even during convalescence the patient has been known to incubate the disease afresh, and this process may be repeated more than once.

Diagnosis.—Almost any affection of the throat *may* be mistaken for diphtheria, but the mistake is only likely to happen in the case of acute follicular tonsillitis, scarlet fever, and syphilitic affections. Their points of difference may be summarised thus:—

1. *Acute follicular tonsillitis.*—Here the amount of fever may be equal to or even greater than that found in diphtheria. Usually the fever begins more suddenly, without prodromata, and is accompanied by more pain in the throat and more disagreeable general symptoms than occur in the early stage of diphtheria. In fact, the less serious disease has in most cases the more severe symptoms. In acute follicular tonsillitis, even from the first, exudation can be seen issuing from the tonsillar crypts, forming many small white points upon the surface of the swollen tonsils, and nowhere else. In diphtheria some hours, or even days, usually elapse before more than one patch of membrane is seen, and this may possibly not be upon the tonsil; or, if there be more than one, a patch situated elsewhere than on the tonsil will decide the diagnosis. The diphtheritic membrane, too, soon becomes thick and leathery, and is not easily removed, while the exudation of tonsillitis remains soft and creamy and is easily wiped away with a brush. In acute tonsillitis nasal catarrh is not often met with, while in diphtheria of moderate severity it is frequently an early symptom.

2. *Scarlet fever.*—Diphtheria rarely begins with the same suddenness as scarlet fever; and vomiting, too, is not usually an early symptom. The temperature in scarlet fever rapidly rises to a height which is rarely found in diphtheria, and then only in the later stages of an acute attack. After twenty-four hours, too, the scarlet-fever rash appears. This may possibly be mistaken for the erythema rarely seen in diphtheria. But the diphtheria-rash, when present, does not spread over the whole body, being limited to the upper parts of the chest and the neck; it is not punctate; and it is never an early symptom. The special albuminuria of scarlet fever first makes its appearance late in the disease or at the beginning of convalescence; and if albuminuria should occur earlier, it is only slight, and such as may accompany any febrile state. The urine, too, in scarlet fever frequently contains blood together with the albumen. In diphtheria, on the other hand, albuminuria is an early symptom; and in a doubtful case, if the urine contains much albumen after only two or three days of the fever, a diagnosis of diphtheria is the more probable. The urine in diphtheria rarely contains blood. The throat affections of the two diseases may resemble each other very closely, for in scarlet fever, not only may the slough of the mucous membrane simulate the false membrane of malignant diphtheria, but, as already stated, there may occur in scarlet fever a false membrane having the same pathology as that of diphtheria. Yet, in scarlet fever, ulceration is more prominent than in diphtheria; shreds of membrane are not expectorated, and there is no tendency of the throat-affection to spread to the larynx. The writer has already mentioned, as his opinion, that in the cases where laryngeal affection has ensued upon scarlatinal symptoms, there has been a double infection by the two poisons.

3. *Syphilitic affections.*—Syphilis, in the secondary stage, may produce white patches over various parts of the throat, due to coagulative necrosis of the epithelial cells. These may be mistaken for diphtheritic membrane. But they are never accompanied by so much fever as occurs in diphtheria; they are not so raised as diphtheritic patches; and the parts around are not so swollen as in diphtheria. Moreover, the rash of secondary syphilis present on the body-surface at the same time is diagnostic. The ulceration of the throat which may appear in the tertiary stage of syphilis might be mistaken for a diphtheritic condition during an epidemic of diphtheria; but the remembrance of the possibility of its

occurrence should be sufficient to remove the chance of error.

The paralysis of diphtheria has the characters of paralysis due to peripheral neuritis, in the article upon which subject details will be found as to its diagnosis. The special characters distinguishing it as of diphtheritic origin are—the history of the throat trouble, if this be obtainable; the peculiar progress of the paralysis; and the early affection of the palate and eyes, which are rarely touched by other forms of peripheral neuritis. *See* NEURITIS, PERIPHERAL.

PROGNOSIS.—The prognosis in diphtheria must always be guarded, even in the mild cases, for serious symptoms may at any time break out. The prognosis is the more serious the greater the quantity of membrane to be seen in the throat, the higher the temperature, and the greater the weakness and the severity of the general symptoms. The early signs of heart-failure—namely, an unduly slow or very rapid pulse, and the alterations in the cardiac sounds already detailed—are warnings of impending great peril. The malignant form is nearly always fatal; and consequently the occurrence of much hæmorrhage from the throat or nose, a gangrenous condition of the false membrane and surrounding parts of the throat, or signs of much nasal affection, are of grave significance. The occurrence of albuminuria adds nothing at all to the severity of the original disease, and therefore is *per se* of no consequence in judging the prognosis. But, with this exception, any one of the complications mentioned above adds to the gravity of the attack. This is especially the case with extension of the disease to the larynx, which, if unrelieved by operation, in nearly all cases will kill the patient. After operation, too, a large number of patients die either from the severity of the original attack, or from extension of the membrane down the bronchi and consequent occurrence of diffused pneumonia. In the experience of the writer, those cases of laryngeal diphtheria which have followed on scarlatinal symptoms are specially fatal. Generally speaking, the prognosis is the less favourable the younger the subject.

The prognosis of diphtheritic paralysis is on the whole favourable. Nearly always the paralysis recovers. The unfavourable cases are those in which the muscles of the larynx and those of the trunk are paralysed.

TREATMENT. — 1. *Prophylaxis.* — Diphtheria is undoubtedly both contagious and infectious. The infection lies in the exhalations of the patient, and especially in the portions of false membrane expelled from the throat. For this reason it is necessary that a case of diphtheria should be stringently isolated, and that all false membrane coughed up should be at once received into a vessel containing an antiseptic fluid, such as carbolic acid (1 in 20) or perchloride of mercury (1 in 500). During the course of an epidemic no milk should be partaken of by healthy persons unless boiled shortly before being used. In the light of our present knowledge, doubtful though this may be, it would also be well to banish cats and birds from a household during an outbreak of diphtheria. Löffler has fixed eight days after the apparent disappearance of the disorder, as the period during which a patient should remain in quarantine.

2. *Surroundings of the patient.* — The patient should be kept in a warm, well-ventilated room. If there is any sign of affection of the respiratory passages the air of the room should be kept moist, and this may be effected by allowing the nozzle of a bronchitis-kettle to enter within the covering of a tent-bed. A warning may here be given that, without due care, *cool* and not *hot* moisture may thus be supplied to the patient, and may be extremely harmful by depressing the vital powers and inducing pneumonia. Heed to this point is especially necessary after the performance of tracheotomy.

3. *Diet.*—The extremely weakening effect of diphtheria must always be borne in mind, and every effort made to help the patient to assimilate nutriment during the attack. This, however, is a difficult matter, for not only does the patient frequently loathe food, but if, in spite of this, it be administered in injudicious quantities, vomiting may be set up, which will totally preclude nutriment being given in the ordinary way. In these matters the judgment of the careful physician may be taxed to the utmost, and must decide on the merits of each individual case apart from any general laws. As a rule, milk must be the staple article of diet. It may with advantage be peptonised, and mixed with lime-water or soda-water in the proportion of 2 in 3. It should be given at intervals of two hours, or, if only small quantities can be taken at a time, every hour. With it, twice or thrice a day, the yolk of an egg may be beaten up, or arrowroot boiled in milk may occasionally be substituted. Again, strong beef-tea should at intervals be given, not only as a relief to the milk-diet, but also for its stimulant effects. If the condition of the throat do not debar the patient from swallowing them, beef-jelly, or chicken- or beef-essence, may be given similarly. Where milk disagrees, raw beef-juice will sometimes be found of great value. Children will not infrequently refuse to swallow food, even when the throat-affection does not interfere with its passage. Here two means may be made use of to maintain the nutrition: either the child may be fed by the nasal tube, a disagreeable proceeding which is rarely applicable in diphtheria, or the feeding may be carried on *per rectum* by means of nutrient enemata or suppositories. The latter method must always be resorted to when severe vomiting prevents food being given by the mouth.

4. *Stimulants.*—Alcohol is needed in every case of severe diphtheria, and is best given in the form of champagne or brandy, at intervals of two or three hours, in quantities proportionate to the age of the patient and the severity of the attack. It must always be given freely when any of the signs of cardiac failure are perceived.

5. *Internal medication.*—Of recent years rational therapeutics has been employed with great advantage in the treatment of diphtheria. The disease has long been thought to be due to the action of germs or of the products of their growth, and for this reason many germicide remedies have been proposed. Quinine was used before any such theories were mooted, but is a most valuable remedy. Again, the perchloride and also the periodide of mercury have been employed with great success. The perchloride of mercury, $\frac{1}{20}$ to $\frac{1}{16}$ of a grain, with sulphate of quinine 2 grains, administered to an adult patient every third or fourth hour, is an efficacious combination. The periodide of mercury can best be given in the soluble form recently introduced by pharmacists. A still more powerful drug, the cyanide of mercury, has been recommended, but cannot be other than a dangerous remedy. Salicylic acid and its compounds, too, have been used with apparent benefit. Of the older and empiric remedies, perchloride of iron and chlorate of potassium have been the most employed, and are undoubtedly of great value. They may be given in combination together with glycerine, and the iron should be administered freely so long as vomiting does not occur. The general antifebrile remedies may also be given in diphtheria, but acids are preferable to alkaline compounds, since the latter are depressing to the circulation. On no account whatever should antifebrin, antipyrin, or any of the so-called new antipyretics be used in diphtheria.

The number of other drugs which have been employed in the treatment of this disease is very large, but as the writer has no experience of them he can do no more than mention them. Amongst them are peroxide of hydrogen, hyposulphite of sodium, and turpentine, not to say chloral and jaborandi, which in the opinion of the writer are dangerous.

The older physicians frequently administered emetics in diphtheria, with the object of detaching and expelling false membranes from the air-passages and throat. Their results from this treatment were often good. But now that more is known of the heart-failure so common in diphtheria, and of the depressant effects which emetics have upon the circulation, they are used more rarely. If employed at all, only the least depressant, such as sulphate of zinc, ipecacuanha, or apomorphine should be given.

6. *Local remedies.*—The throat is the locality from which the specific poison of diphtheria is absorbed into the system, but it is very doubtful whether remedies applied thereto are of any effect upon the poison itself. Nevertheless, we have in diphtheria a poisoning by general septic matter, the result of the putrefactive changes going on in the throat, and much good can be done by remedies which arrest this process. No force whatever should be used to remove the membranes, but the throat should be sponged out frequently with a solution of perchloride of mercury (1 in 500), of carbolic acid (1 in 40), or of resorcin (1 in 20). An excellent application, too, is the solution of the perchloride of iron, either alone or mixed with an equal quantity of glycerine. The tincture of iodine applied locally has also been found very beneficial.[1] These applications may be alternated with the use of the carbolic spray. A large number of other applications have been recommended at various times, but those just mentioned will be found the most useful. Many of those which have been used have no other merit than that of being harmless. Some, such as papaïn, &c., have been recommended because they had the power of dissolving diphtheritic membrane outside the body. They have, however, not been found so efficacious in dissolving the membrane *in situ*; and, if they had been, they would only have been of use when the membrane attacked the air-passages. Their thorough application, in such conditions, is difficult or impossible, and, moreover, in the same circumstances, other treatment is more urgently required.

7. *Treatment of certain complications.*—(*a*) *Spread of the membrane to the air-passages.*—In view of the extreme fatality of this complication, operative treatment is at once called for, as soon as it is diagnosed by the signs already detailed, even though it be in an early stage. The opinion of surgeons is as yet divided as to the comparative merits of tracheotomy and Dr. O'Dwyer's intubation of the larynx, but one or other operation must be performed. It is true that even after this the prognosis is still bad, for death from pneumonia is very common; yet the best chance has been afforded to the patient.

(*b*) *Spread of membrane to the nares.*—When this occurs, antiseptic solutions similar to those used for the throat should be injected frequently into the nares. Care, too, should be taken to quickly wipe away all secretion issuing from the nostrils, in order that excoriations and secondary infection may be avoided.

(*c*) *Vomiting.*—This is best treated by the sucking of ice, and the administration of carbolic acid, creasote, or bismuth. Ice to the epigastrium, or a blister over the epigastrium, will frequently be of use; but if a blister be used, care must be employed that the resulting sore be not infected by the diphtheritic membrane. If the vomiting is severe, food must be given by the rectum.

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[1] In a note to the writer, Dr. Adamson, of Rye, reports highly of the *internal* use of tincture of iodine in frequent doses of 3 to 7 minims. It produced no ill effects, and was easily taken.

(*d*) *Heart-failure.*—Here free stimulation must be resorted to, both during the attack and when it is threatened. During the attack remedies are not of much avail, for death is so frequently sudden; but, if possible, nitrite of amyl or nitroglycerine may be administered. The subcutaneous injection of liquor strychninæ hydrochloratis in doses of three minims repeated every half hour (for adults) will sometimes tide the patient through the dangerous period. When the signs of heart-failure are perceived, even if the patient is apparently convalescent, he must be kept in the recumbent posture at absolute rest. General tonic remedies should be given, together with strychnine, iron, and digitalis.

(*e*) *Paralysis.*—For this complication the most efficacious remedies are good diet, good air, and the administration of iron and strychnine. Massage, when the extremities are affected, is often of value, and the application of a weak faradic current seems sometimes to promote recovery.

Robert Maguire.

DIPHTHERITIC.—Relating to diphtheria. The term is applied to the membrane formed in diphtheria; and it is also associated with certain symptoms occurring in the course of the disease, such as diphtheritic paralysis. *See* Croupous; and Diphtheria.

DIPLOE, Diseases of.—*See* Skull, Diseases of.

DIPLOPIA (διπλόος, double; and ὄπτομαι, I see).—Double vision. *See* Strabismus.

DIPSOMANIA (δίψα, thirst; and μανία, madness).—Synon.: *Oinomania*; Fr. *Manie Ébrieuse*, or *Crapuleuse*; Ger. *Trunksucht*.

Definition.—An irritable condition of the nervous system, characterised by a craving, generally periodic, for alcoholic and other stimulants.

Ætiology.—This peculiar condition may be brought on by a course of intemperate drinking; but it is seldom the result of that cause alone, and is not infrequent in persons who have never been intemperate prior to the development of the morbid craving. The occurrence of this form of insanity, as of other degenerative nervous diseases, may generally be traced in the family history of the patients. But sunstroke, a blow on the head, or other direct injury to the brain may excite it; and it may be symptomatic of epilepsy, or of structural disease of the brain. It may be developed at any period of adult life; but most frequently declares itself during the pubescent and climacteric periods.

Symptoms.—An instability of character and indications of peculiar nervous irritability may generally be recognised as having preceded the distinct development of the craving. It is also usual to find such persons as are predisposed to the disorder abnormally sensitive to the influence of stimulants. Sometimes very small quantities of alcohol produce appreciable intoxication. The duration of the periods of craving is variable; but most commonly they last one or two weeks. The remissions continue for periods varying from two to twelve months. During the period of craving the whole moral being is enthralled by the morbid desire; and the regard for truth, decency, or duty is generally altogether lost. Moderate indulgence in a stimulant may bring on the morbid craving; but the desire is frequently developed without any such introduction. Members of the household in which a patient lives can indeed often recognise the indications of a coming attack by a restlessness and depression which precede any such indulgence. During the intervals the patient seems, except when the brain has been weakened by frequent attacks, to recover completely; and he generally displays great confidence in his ability to resist the tendency in future. Repeated attacks always produce a permanent degradation, both intellectual and moral; and if the patient live long enough he lapses into a state of dementia. It sometimes happens that some cerebral lesion, of which the dipsomania had been symptomatic, manifests itself in paralytic or convulsive symptoms; and the appearance of such phenomena is often accompanied by a modification of the craving.

Diagnosis.—True dipsomania may easily be, and often is, confounded with mere habitual drunkenness. In dipsomania, however, there is, as a fundamental condition, a pathological condition of the brain which manifests itself irrespective of external circumstances of temptation. In habitual drunkenness the craving consists mainly in a desire to keep up a condition of stimulation to which the brain has become accustomed. The habit is the result merely of compliance with a vicious custom, and there is no such periodicity or independence of external influences in the symptoms as is found in the true disease.

Treatment.—Prolonged abstinence from stimulants, and adherence to the tonic regimen, are the only measures from which any amelioration can be hoped for. It is seldom possible to restrain the gratification of the craving without compulsory seclusion; and even when this has been successfully enforced for a considerable period, the morbid tendency is seldom eradicated. By the 'Habitual Drunkards Act, 1879,' amended and made perpetual by the 'Inebriates Act, 1888,' a person who is, by reason of habitual intemperance, at times dangerous to himself or others, or incapable of managing himself or his affairs, may, upon his own written application, attested by two justices, be admitted into a licensed 'Retreat,' and detained for such period, not exceeding twelve months, as he may specify in such application. Several retreats have been licensed under the provisions of this Act for the treatment of dipsomaniacs, with, in many cases, satisfactory results. JOHN SIBBALD.

DISCRETE (*discerno*, I separate).—This adjective is used in reference to certain cutaneous eruptions, in which the spots or pustules are separate from each other; for example, discrete small-pox as distinguished from confluent.

DISCUTIENTS (*discutio*, I drive away).

DEFINITION.—Local applications which are supposed to remove or disperse the congestion and effusion of inflamed parts, and the swelling of the skin over them.

ENUMERATION.—The chief discutient measures or agents are:—Friction; Pressure; Warm moist applications; Counter-irritation by blisters or liniments; Mercury and its preparations; Iodine and its preparations, including the Iodides of Potassium, Lead, and Cadmium.

USES.—These remedies are generally applied over enlarged joints, enlarged glands, or cystic tumours. The most powerful amongst them are blisters, which sometimes remove enlargements with great rapidity; next to these come mercury and iodine and their preparations, either alone or in combination. Their action is aided by heat and pressure. The effect of the former is seen in the Indian treatment of goître, which consists in rubbing iodide of mercury ointment over the tumour, and exposing the patient to the full rays of the sun, or to the warmth of a large fire. The beneficial effects of pressure are observed in the diminution which takes place in enlarged and swollen joints under the application of mercurial ointment or strapping, the friction with the hand in applying the ointment, and the pressure exerted by the strapping greatly increasing the efficacy of the mercurial preparation in removing swelling. *See* FRICTION. T. LAUDER BRUNTON.

DISEASE (*dès*, from; and *aise*, ease). SYNON.: Fr. *Maladie*; Ger. *Krankheit*.

DEFINITION.—Disease may be defined as a deviation from the standard of health in any of the functions or component materials of the body. *See* PATHOLOGY.

The expression 'a disease' is frequently used with reference to a supposed unit of causation. Thus, it may be applied to some simple phenomenon, for example, neuralgia, when that phenomenon is the sole effect of a cause, such as a carious tooth; or it may include many concurrent or consecutive resultant phenomena, such as those of syphilis or typhoid fever.

GENERAL CONSIDERATIONS. — It is well known that changes of function and of structure are brought about and influenced by a great variety of agencies. These agencies, some of which act from within, others from without, are recognised as the *causes* of disease. Such changes, whether they be functional, affecting more especially the vital properties of the body without manifest alterations of structure, or structural, clearly affecting its physical properties, constitute what is familiarly known as DISEASE, which is hence said to be *functional* or *structural* respectively. These changes are merely the evidence of an altered or perverted action, which is then in operation or has already occurred, the nature of which is considered under the head of PATHOLOGY. When these deviations from health can be recognised during life they are described as the *symptoms* or *signs* of disease. For example, when a person, after exposure, it may be to wet or to cold, or both, is found to have an increase of temperature, with a quick pulse and perverted secretions, to complain of thirst, and of pain at the joints with effusion in and around them, we say that such person is labouring under disease; and we call it 'rheumatism,' because that name has been assigned to a complexus of deviations from health, such as those then presented by this individual. When typhoid poison has been introduced into the body, it leads in like manner to a number of functional and structural changes, which, taken together, constitute what we call 'typhoid fever.' Or, again, under certain circumstances there appears to be generated in the system, whether as the result of a tendency established before birth (hereditary) or by habits of life (acquired), an agency which, acting morbifically, produces a series of phenomena which we call 'gout.' These several forms of disease may be *classified* in groups, arranged in accordance with the causes which give rise to them, or their nature, their seat, their duration, &c. Rules are laid down for the modes of distinguishing or *diagnosticating* one disease from another; for *prognosticating*, as far as may be, their result; and for their *prevention* and *treatment*.

Thus it comes that the discussion or description of any *particular disease* consists of an account of the causes that give rise to it, or its ÆTIOLOGY; the changes of structure or of function which constitute it, that is, its ANATOMICAL CHARACTERS and PATHOLOGY; the phenomena attending these changes, otherwise, the SYMPTOMS and SIGNS of the disease; the facts that serve to distinguish this particular disease from other diseases, that is, its DIAGNOSIS; the means of forecasting its progress and termination, which constitute its PROGNOSIS; and finally the measures by which it may be prevented, relieved, or removed, that is, its TREATMENT. Throughout this work the various diseases are, as far as is practicable, discussed upon this uniform plan.

It is well to remember that, as thus understood, DISEASE is an abstract or relative term, and not an entity having a special and independent existence. Physiology has in recent days diffused a clear and penetrating light over many of the processes of life in health, which were previously dark and obscure. Pathology, which is physiology applied to the study of unhealthy function and structure, earnestly follows the footsteps of the sister science. We are therefore not hoping and believing too much when we express our conviction, that the time is not remote when we shall be able to trace those early and subtle changes which constitute disease, as well as the causes which give them origin, and that we shall thus be enabled to define in a more philosophic form and with more practical results what disease really is. In the meantime we must be content to work upon the phenomena before us, to investigate so far as we can the causes of disease, how to recognise its presence and its nature, how to estimate its progress and its duration, and finally how to prevent its occurrence or to cure it when it has occurred. These varied and important points will be found discussed, as above stated, under suitable headings, in the articles immediately following, and in other parts of this work.

RICHARD QUAIN.

DISEASE, Causes of.—DEFINITION.—Whatever is capable of damaging the structure of any organ or tissue of the body, or of interfering with its function, may be a cause of disease. This definition implies that such causes are numerous, and that of many of them science is yet ignorant. To give a succinct account of them is therefore difficult, nor is the difficulty diminished by the fact that, in most diseases, we can trace a succession or combination of causes.

GENERAL CLASSIFICATION.—The causes of disease have been divided into (1) *Predisposing* or *Remote*, and (2) *Exciting* or *Proximate*. Illustrations will explain what is meant by these terms :—Two individuals are exposed to the contagion of typhus in equal degree; one, wearied by bodily and mental labour, 'catches' the disease—that is to say, his condition has *predisposed* him to the exciting cause of the malady; the other, in vigorous health, escapes the contagion—the *exciting* cause of disease. Predisposition in fact *prepares* persons by rendering them more susceptible to the influence of exciting causes of disease. Many persons are *predisposed* to emphysema because of heredity; they contract bronchitis, which, by its attendant cough, easily *excites* the malady. Such illustrations might be extended to a multitude of diseases. Predisposition may be inherited; or it may be acquired, and be due to various accidental causes. In most cases there is a combination of predisposing causes; in a man, for example, lowered by fatigue, want of food, exposure and debauch, an attack of bronchitis or pneumonia will be readily excited. Though where many factors unite in creating the predisposition to disease, it is not infrequently possible to estimate the part played by each, yet practically it is often difficult to say even how much is due to predisposition.

Moreover it is not always easy to distinguish predisposing from exciting causes. Predisposition carried to excess becomes in some cases an exciting cause of disease, and often there is a combination of both causes. There are certain distinct exciting causes—for example, heat, cold, or injuries of various kinds; but most of these can also claim a predisposing power. The contagia of specific diseases are good examples of direct exciting causes.

In proceeding to discuss the subject of ætiology, no attempt will be made to separate definitely predisposing from exciting causes of disease. The writers will endeavour rather to indicate as far as possible, under the head of each factor of causation, the direction in which it especially acts.

The following causes will be considered: (1) *Race*, (2) *Heredity*, (3) *Sex*, (4) *Age*, (5) *Intermarriage*, (6) *Temperament*, (7) *Climate*, (8) *Town and country*, (9) *Hygienic conditions*, (10) *Occupation*, (11) *Air*, (12) *Previous disease*, (13) *Mental and moral conditions*, (14) *External physical conditions*, (15) *Cold and chill*, (16) *Poisons*, (17) *Diet*, (18) *Epidemic diseases, contagion, malaria, parasites, and growths*.

1. **Race.**—The statements formerly adduced to show the influence of this factor of life in the production of disease, have been of late years subjected to a searching criticism, with the result that many are either rejected as inaccurate, or resolved into other factors, such as climate, dress, and diet.

What is left of them may be thus summarised. 'Lethargy' and 'ainhum' are diseases peculiar to negroes, who also seem especially liable to small-pox and leprosy. In the same race, on the other hand, hæmorrhoids and calculi are unusually rare; and an almost complete immunity from yellow fever is enjoyed by its members. This immunity is said to be proportioned to the purity of the race, but probably may be lost or diminished by residence in a colder zone (Hirsch). Among Europeans, the manifestations of hysteria and insanity are most marked in the Latin races.

2. **Heredity.**—This is one of the most complex predisposing causes, and is therefore proportionately difficult to estimate. In the first

place it is unquestionable that certain specific diseases, such as small-pox and syphilis, may be directly transmitted from parent to child. The second and more complex problem is to determine whether or to what extent immunity from, or susceptibility to, specific contagia, disordered functions, or diseased tissues, can be transmitted from parent to child. The terms 'temperament' and 'idiosyncrasy' are, as Mr. Hutchinson has pointed out, simply expressions of individual heredity.

A virgin community suffers more severely from an epidemic of small-pox than one in which the disease has long been known. Some kind of transmitted immunity is therefore probable. Some specific diseases run in families. Of these the best example is tubercle, with which have been classed leprosy and even typhoid fever and diphtheria. Here it is probably a predisposition to, not a direct transmission of, the disease in question. There is amongst mankind not only an inheritance of such prominent diseases as phthisis, but of peculiarities in the manner they meet and pass through minor ailments. Thus, in families with a 'nervous history,' we meet with predisposition to headaches of nervous type, irregularities of digestion in the form of diarrhœa and vomiting, and a multitude of conditions which have been ascribed to vasomotor disturbances. The members of some families live long in spite of exposure to almost every exciting source of mischief, and contrast most favourably with others who, as far as one can determine, have all things in their favour. There is no doubt that a tendency to gout, the hæmorrhagic diathesis, pseudo-hypertrophic paralysis, Friedreich's disease, hay fever, enuresis, and other diseases is handed down from generation to generation. Of many minor complaints there is less certainty; but it is exceedingly probable that persons are predisposed to bronchitis and other catarrhs by inheritance. It is acknowledged that epilepsy descends from parent to child, and that, in fact, individuals, because of heredity, are often the subjects of nervous diseases excited by causes which those from a different stock are enabled to throw off readily. The various forms of insanity are striking examples. It is supposed that the inheritance lies in the tissues themselves—that there is a something in the tissue-elements which predisposes to certain diseases in certain families. Too much attention is generally bestowed on direct transmission of diseases from parent to child, and too little on tendencies resulting from the sum of forces acting through the innumerable generations of the past. *See* ATAVISM; and HEREDITY.

3. **Sex.**—There are great differences in the organs and functions of the sexes, and in consequence a great contrast in their predisposition to disease. The female is more delicately constructed than the male, and those organs which the two sexes possess in common differ in weight and in 'fineness'; and a general consideration at once indicates that the female is less fitted than the male to resist many exciting causes of disease. This is particularly evident at climacteric periods of life: with the onset of puberty girls suffer far more than males, and especially from a variety of reflex spasmodic disorders, which require but little provocation for their development. All the phenomena classed under the head of hysteria often occur at this period. At the same time, and shortly afterwards, there is a tendency to ulcer of the stomach, to persistent constipation, to peculiar attacks of neuralgia—especially of the intercostal nerves, and to acute rheumatism, lapsing into the subacute or chronic kind. Anæmia and chlorosis are also commonly met with at the period of puberty, and if then neglected they are apt to persist, and predispose the individual still more to disease. Goître, too, is more prevalent among females than among males.

Even so early as the period of puberty the external circumstances of the sexes differ, and on this depends, in a certain measure, the difference in their predisposition. Education, domestic habits and customs, and, above all, occupation, play an important part, and these are largely influential in the production of the diseases just mentioned. But, underlying these outside influences, there is inherent in the sexes a difference in predisposition; for when they are exposed, as often happens, to the same surroundings, they suffer from widely separated diseases. Males are more subject to epilepsy, tetanus, gout, diabetes, locomotor ataxy, pseudo-hypertrophic paralysis, hæmophilia, vesical diseases, and acute lung-affections, than females. The list shows that occupations which involve hard mental and bodily work and constant exposure explain some of the varieties in predisposition. It is probable that females are more frequently ailing than males, but very often their illnesses are associated with the menstrual functions, and are trifling in degree; and, though more males are born than females, towards the later years of life the average of the sexes becomes more equally balanced, or even reversed, because the mortality of males is greater than that of females. It is sufficient to allude to the fact that pregnancy and lying-in predispose females to diseases from which males are entirely exempt; and that there is a considerable difference in the sexes as regards venereal affections, both as to predisposition and the effects of the diseases.

4. **Age.**—This has a most important influence as a predisposing cause of disease. In Wagner's *Manual of General Pathology* the periods of age are thus subdivided:—

(1) Nursing age (infancy)—from birth to 7th–10th month.
(2) Childhood—from 1st to 2nd dentition.

(3) Boyhood—from 2nd dentition to puberty.
(4) Adolescence—from puberty to 20th–25th year.
(5) Early manhood—from 25th to 45th year.
(6) Later manhood—from 45th to 60th year.
(7) Old age—from 60th onwards.

This division is excellent, but in no definition is there more need to look out for exceptions than in that of age. The term *age* is strictly comparative; some individuals are old at forty, others young at sixty. Persons fail with regard to particular organs while young in years; and, on the other hand, others acquire an increased power in the same as years advance, of which the brain affords an apt illustration. The minor organs of the body betray the like peculiarities, and in the early decay of teeth, the changes in the hair and the skin, we meet with indications of old age though the individuals are young in years. But, generally, the predispositions of the young and old are striking by their contrast. The young are exempt from fatty degenerations, which are so common amongst those of advanced life, and, in consequence, many diseases amongst them are, *cæteris paribus*, less deadly; and not only does age, by reason of the changes which naturally occur as life goes on, predispose to disease, but all outward conditions become changed. Children—speaking generally—are apt to suffer from acute catarrhal affections of the mucous tracts, glandular diseases, skin-diseases, tuberculosis of acute type, 'scrofula,' inflammation of endo- and pericardium, and a variety of complaints traceable to improper feeding, bad ventilation, overcrowding, and to hereditary tendencies. From acute tuberculosis the aged are almost entirely exempt, and in them the manifestations of hereditary tendencies are observed less frequently than in the young. The very young and the very old are equally subject to bronchial catarrh, and the mortality from this disease at each extreme of life is exceedingly great. But in the young the predisposition to this affection is almost invariably associated with catarrh of the intestinal tract, and diseases which indicate a general constitutional depression; while in the old a predisposition to bronchial catarrh is caused by a degenerative change in the lungs themselves, or in the air-passages. During infancy the nervous system is rapidly developing, and during this stage general convulsions and convulsive disorders, such as laryngismus stridulus, result from slight forms of reflex irritation. As age advances the tendency to spasm decreases, and convulsions become much less marked. The nervous system furnishes other illustrations of 'epochal' diseases. From five to fifteen chorea is common, but differs from convulsions in the greater frequency with which girls are attacked (three to one). Hysteria and the various sensations and vaso-motor disorders which characterise the climacteric period are also largely 'epochal,' and almost exclusively confined to the female sex.

Some of the specific diseases, especially measles, scarlatina, and pertussis, are more common amongst children than adults, which is partly explained by the fact that the latter class have passed through the ordeal of those diseases, and are thus proof against them. Rickets also is essentially a disease of infancy and early childhood.

The onset of puberty is a constant source of predisposition to disease, for with it comes a complete transformation in the mental and physical characters, so that the individual, if not very carefully watched, deviates from even the most perfect health into a permanent tendency to disease. The system at this period—especially in the case of females—is frequently unable to bear anything which interrupts or interferes with its activity. The generative organs undergo great changes, and with them the whole moral and physical nature is altered. At this period of life there is a predisposition to both bodily and mental diseases; and though constipation, want of sleep, and excessive work at school, especially among girls, are important factors in the causation of disease at this time, perversions of any organ or faculty may be started, and, once started, they are apt to continue; so that there is established, literally, a permanent predisposition to disease, and this predisposition swells very largely the list of affections which are dealt with under the generic term Hysteria. Lung-affections—excepting pure bronchitis—are more common at and shortly after the time of puberty than in previous years; but, excepting in the instance of phthisis, hereditary tendencies are less manifested than during childhood. Even hereditary epilepsy is, if postponed beyond early years, likely to be postponed to the period of adult life.

As has been said, the degenerations of organs and tissues begin to show with much uncertainty, but after the fortieth year of life we almost invariably meet with one or other of them. Their degree and their consequences vary with the surroundings of the individual—with his habits, temperament, occupation, and like influences. Diseases of the large vessels are especially common at this epoch, such as aneurysms of the aorta and of the large arterial trunks in the extremities. Henceforward all the diseases peculiar to advancing age become common. The results of previous disease are now declared by a decided predisposition to exciting causes which have been hitherto withstood. Old age is a relative term. A man is old and predisposed to trifling excitants because his lungs have lost their elasticity, or his brain its regularity of circulation, or his heart its vigour: in each of these cases, as in a host of others, the predisposition is strictly one of degeneration—most frequently of the vascular system. Again, inherited diseases do not declare themselves in some cases till the later years of life, and of this carcinoma is a striking example. The old are predisposed to lowering diseases—low pneumonia or bronchitis; and to a variety of nervous affections which the vigorous can resist. In short, they succumb to insignificant exciting causes, because of the general or partial decay of the tissues and textures of the body.

5. **Intermarriage.**—Intermarriage certainly predisposes to disease, but it is not easy to determine how far its predisposing powers extend. Hereditary influences are thereby intensified. If the practice were confined to carefully selected cases, some advantage might ensue. Breeders of first-class animals practise intermarriage, and thereby develop speed, quality, and endurance in the offspring. It is beyond question that this practice of breeders of racehorses is eminently successful for the time, but it by no means follows that the permanent results are good. We are bound to look not only to the immediate, but to the ultimate results of intermarriage —in short, to decide whether intermarriages predispose to disease, to the injury of the community. But no rule, free from exception, can be laid down on this subject, for beyond all doubt many intermarriages have led to both physical, moral, and mental advantages. There is no doubt that malformations are handed down, and that where these are marked in families it is injudicious for persons to intermarry. Where also serious diseases, such as phthisis, insanity, or cancer, have been met with on both sides, it is most advisable that intermarriage should not take place.

6. **Temperament.**—Temperament is only of importance as expressing certain inherited predispositions to disease. It is not in itself either a predisposing or an exciting cause. Many forms of temperament were described by the older writers. According to them, persons of *sanguine* temperament are disposed to congestions of organs, and hæmorrhages, on comparatively small provocation. *Phlegmatic* individuals are the subjects of those diseases which are readily excited by want of mental and bodily energy and activity. A third set belong to the *nervous* temperament; such persons are easily excited and easily depressed, and are prone among other diseases to hysteria or hypochondriasis. Nervous persons suffer quickly from delirium and other brain-symptoms, which aggravate and render dangerous an otherwise hopeful malady. In the acute specific diseases this is particularly manifested; *nervous* people are undoubtedly predisposed to them, and when once attacked are unduly liable to dangerous complications. Practically we meet with 'mixed' temperaments, though one may especially prevail. On the whole, much confusion might be avoided if these terms were altogether discarded, and the connotation of each, stated in definite language expressing what is actually observed in each case, substituted. It would then be evident upon how slight a basis statements regarding temperament are often grounded. *See* TEMPERAMENT.

7. **Climate.**—This includes many factors, all of which may predispose to disease. Amongst these, the influence of altitude, moisture, temperature, season, and soil will be considered :—(*a*) *Altitude.* Dwellers in mountainous regions suffer with excessive frequency from cardiac hypertrophy and from hernia, though the causes of these should be more properly sought under 'occupation' than 'climate.' 'Mountain sickness' is wholly dependent on barometric pressure, and is only rarely met with below a level of 10,000 ft. The prevalence of both malaria and phthisis is almost inversely proportional to the height of the district above the sea-level. Cholera is most prevalent in valleys and plains. (*b*) *Moisture.* Dry air is generally considered less provocative of bronchitis than moist, and this disease may be regarded as one of moist climate. (*c*) *Temperature.* In the tropics various endemic fevers prevail which are unknown in this country, for they cease to exist when the temperature sinks below a certain level (about 60° F.), probably because the micro-organisms concerned in their spread are unable to thrive below that temperature. Frost very often cuts short epidemics in our own country in like manner. Particular organs are predisposed to disease by climate—the liver in the East Indies, the lungs and the kidneys in regions where the temperature is capricious. Tropical heat is essential to the existence of yellow fever, malaria, and dengue; and is an important factor in the production of such diseases as cholera, tropical stomatitis, dysentery, and hepatitis. Heat may kill suddenly, as in sunstroke and heatstroke, or excite cerebral mischief just short of death, especially in confined, ill-ventilated places. Long-continued heat lowers the vital powers, and may excite such slight diseases as eczema of a simple character, or such grave affections as inflammation of the membranes of the brain. Choleraic attacks in this country usually are associated with exposure to immoderate heat. (*d*) *Season.* The influence of season may be resolved into the influences of temperature, rainfall, and prevalent winds. Animal parasitic diseases are more prevalent in the summer. Yellow fever, malaria, and dengue are rife in the summer and autumn, when the rainfall is heavy. Deaths from lung-diseases are most numerous in the winter, and from nervous diseases in the spring. (*e*) *Soil.* No better proof of the tendency to disease dependent upon the nature of the soil can be given than that yielded by the many careful

observations which have shown that where a proper system of drainage of soil-water is carried out, the tendency to pulmonary diseases is very greatly diminished. Clay soils are cold, damp, and impermeable, and favour diseases aroused by these combined agencies; sandy and gravelly soils readily drain themselves, are warm and dry, and thus far tend to protect those who live on them against disease. Climates are also modified by trees, rocks, rivers, lakes, and other physical conditions. Detritus carried down by streams and deposited along their banks or at their estuaries, has, like ground vegetation and its decay, an undoubted predisposing influence in the spread of malaria. The upturning of large tracts with imperfect cultivation is also frequently followed by outbreaks of malaria. Particular districts also predispose to certain diseases. Cretinism is most common in close valleys; urinary calculus is endemic in many districts of Great Britain and elsewhere. In some circumscribed areas in Scotland, in Norfolk, and other districts, individuals are especially liable to stone.

Fogs in large cities depress most people; and it is not too much to say that many diseases may be traced to a predisposition which 'bad weather' has started. Alcoholism has been provoked in this way. It is clear, therefore, that under the head of climate there are many combining influences, which affect the moral, mental, and bodily nature of individuals, and through one or all may predispose to disease. In this country, and probably elsewhere, those who dwell on mountains are less liable to disease than the dwellers on plains—marshy plains especially. New comers are more prone to the endemic diseases of a district than the natives. The best instances of this are dysentery and malaria. It should be remembered, however, that it is not climate alone which varies the predisposition amongst persons residing in different regions; for their habits, diet, and social conditions differ far more than the climate in which they dwell, and predisposition to disease should never be ascribed solely to climatic conditions unless accidental influences have been investigated and eliminated.[1] *See* CLIMATE.

8. **Town and Country.**—The influences of town and country, as predisposing to disease, require separate consideration. With them may be considered dwellings, and a variety of minor sources of predisposition. The mortality of country districts is less than that of towns, but towns differ in this respect amongst themselves. The health of the largest city in Great Britain, for example, compares favourably with any of the large manufacturing towns and with many rural communities. It is easy to understand that differences must depend on the occupation, food, and habits of the people, and on their external surroundings—air, light, drainage, and like conditions. In larger towns occupations are more lowering than in country districts; while the physical and mental strain is greater, and has fewer interruptions. Late hours, intemperance, and prostitution prevail in towns; but it is by no means certain that, in proportion to the population, these ills are less frequent in the more remote districts. In towns overcrowding checks ventilation, makes drainage difficult, so that subsoils become saturated, clouds the atmosphere with smoke and dust, intermingles the sexes (amongst the lower classes), so that succeeding generations are stunted in their development, and in a variety of other ways predisposes to disease. But in some towns these evils have been obviated by sanitary measures, and as a consequence towns often predispose less than country districts to diseases due to defective drainage and overcrowding. Some startling illustrations of this fact have occurred since sanitary science has been acknowledged to be of national importance. In villages, for instance, reputedly 'model,' epidemics of disease associated with defective drainage and evil domestic arrangements have decimated the inhabitants, and the virulence of these epidemics has been greater than that of those met with in large towns. The latter are nowadays for the most part better drained than country districts; thus milk-epidemics of typhoid fever have been imported into large cities from isolated farms where the drainage alone seemed to be at fault. Amongst children rickets, scrofula, tuberculosis, and choleraic diarrhœa are far more prevalent in town than country; and the more crowded the population the greater the mortality from phthisis. The mortality amongst young children is far greater in towns than in country districts. Adulterations are an evil in large communities, affecting people of all ages. From many of these country districts are free. Unadulterated milk is now as easily obtained in towns as in the country. So while dwellers in the country may have bad drainage and bad houses, they have pure air, as a rule, and every opportunity of breathing it out of doors. Even the alcoholised drinks in many country districts are home-made and harmless when compared with the adulterated raw spirits taken by the lower classes of large towns. On the other hand, however, dysentery is a disease of villages rather than of towns.

9. **Hygienic Conditions.**—One of the most common causes of disease coming under this head is want of cleanliness. To this is

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[1] Imperfect drainage leads to what are popularly known as 'damp walls' in dwellings, and thus predisposes to pulmonary diseases by interfering with ventilation—in fact, by preventing the admission of pure air into such dwellings. This truth bears out the teachings we have derived from Dr. Buchanan's investigations at Ely and elsewhere.

due a variety of skin-diseases, such as eczema of the scalp in children, and diseases caused by pediculi. It interferes with the functions of the skin generally, and by it even a common cold is modified. Clothing is a part of the subject. Insufficient, improper, or excessive clothing are most important sources of predisposition, amongst the rich as well as amongst the poor; for, though the climate of this country is so variable, corresponding adaptations of dress are for the most part neglected. Clothing is used to prevent the loss of heat, which occurs in three ways—by radiation, conduction, and evaporation; and a proper adaptation should prevent undue loss of heat, allowing for the escape, instead of ensuring the condensation, of the secretions from the skin, and should be sufficiently loose to permit the movement of the limbs and thorax. Non-conducting, loosely woven, flexible materials are clearly the best adapted for this purpose. Neglect of these requirements is largely instrumental in the causation of disease, particularly in young women of our large towns. A very common cause of predisposition to disease is neglect of proper bedding. Deficient ventilation and overcrowding are prolific sources of mischief. Overcrowding and insufficient ventilation are among the greatest evils of our chief cities and towns; and not only is it in their homes and workshops that populations are overcrowded, but in their places of recreation and of religious worship. Briefly it may be said that overcrowding predisposes to moral, mental, and physical deterioration; to all communicable diseases, including all septic and parasitic conditions, and especially to typhus fever and tubercle; to pulmonary affections; and to a variety of nervous diseases. By lowering the *morale* of populations it increases all other predispositions, and, in fact, passes into an active exciting cause of disease.

10. Occupation.—Occupation acts in two ways as a factor in the production of disease. (1) It may expose the worker to certain deleterious influences which are themselves exciting causes of disease. Of this class the best illustration is furnished by workers in poisonous substances, such as antimony, arsenic, copper, brass, lead, mercury, mineral acids, phosphorus, and indiarubber. Turners, knife-grinders, and stone-masons suffer from inflammatory diseases of their air-passages and lungs, induced by the inhalation of fine particles resulting from their work. Corns, chronic inflammatory nodules, and various deformities are produced in those whose occupation involves constant pressure on any one part. Shoemakers and chair-makers illustrate this statement, the latter presenting a characteristic corn and subjacent pleural thickening in the first right interspace.

(2) Occupation has a still wider predisposing influence. The general health may be lowered, and the resisting power diminished, by the conditions of life in which many occupations are carried on. Among these are (*a*) the *breathing of vitiated air* due to overcrowding or to deficient ventilation; (*b*) *deficient exercise*; (*c*) *exhaustion*, physical or mental, from overwork; (*d*) the *excessive use of particular parts* of the body; (*e*) *exposure* to cold and wet, or to excessive changes of temperature; (*f*) improper or irregular *feeding*; (*g*) or, on the contrary, absence of adequate employment. These influences are often combined and their effects proportionately increased.

Physical overwork is often conjoined with exposure and improper or irregular food-supply, and the combination has a marked effect. It has so predisposed armies to disease that their ranks have been decimated by fever, pneumonia, and bronchitis, far more than by actual fighting. Not a few medical men have been affected by the contagia of the acute specific diseases, because when exposed to them they were worn out by bodily and mental exertion, and by protracted fasting.

Many other illustrations might be given. Soldiers are most liable to thoracic aneurysm and sunstroke; and young women with no fixed employment, or exhausted from overwork and anxiety, to hysteria. A coachman who uses for many hours his pectoral muscles in driving, suffers chiefly in them when he has an attack of muscular rheumatism.

Many of the diseases mainly dependent on occupation may be avoided or alleviated by careful attention to hygienic precautions.

11. Air.—The question of air has already been alluded to, in considering climate, occupation, town and country, overcrowding, &c., and it is scarcely necessary to dwell much more on its ætiological effects. Air influences the predisposition to disease according to its degree of rarefaction, moisture or dryness, warmth or coldness, and the impurities, mechanical or chemical, which may adulterate it. In the article CLIMATE many of these atmospheric conditions are fully dwelt upon, and their tendencies explained. Impurities in the air are exceedingly prevalent; and mechanical substances suspended in it can excite irritable conditions of the air-passages which may pass on to inflammation, and even destruction, of the lungs. Pharyngeal and laryngeal affections are a common consequence of these impurities, and occur largely amongst certain classes whose occupation loads the air with fine particles as already described. There is scarcely a mineral used in the arts which cannot, by inhalation, excite or predispose to disease. The air may also be rendered impure by chemical agencies, and the moment the normal proportion of its elements is disturbed it becomes a source of disease. Excess of carbonic acid is especially an element of mischief—causing headache, dyspepsia, and nervous depression. The presence of ammonia and of sulphuretted hydrogen is attended by like results. The human economy is, however, so framed that its organs can often very rapidly throw off the evil effects of these gases when breathed in overcrowded rooms, so that no permanent mischief is established. Poisoned air plays a part in the production of tubercle, anæmia, and lowered conditions generally; but it is an incomplete comprehension of the causes of these conditions to set down all to this one. The air, also, may be poisoned by other gases, such as carburetted hydrogen.

The atmosphere is modified by currents—sometimes to the relief, sometimes to the damage of mankind. Winds can remove sources of contagion—they can 'clear the air.' But according to many authorities they can also bring contagion into localities. Cholera and other diseases have, it is said, followed aërial currents, that is, have been carried by them. The influence of winds upon health varies with the individual concerned. Some persons are invigorated by warm south-westerly breezes. A north-easterly wind will stimulate the energy of one person, but reduce another to a condition of abject misery. The colder winds generally exert their tonic action to most advantage during the middle periods of life. While easterly winds prevail, acute lung-diseases prevail, particularly in the aged. Eczematous conditions often owe their origin to the same cause.

12. **Previous Disease.**—Previous disease often predisposes to the same or to some other affection, and no clinical history is of value unless it includes an account of former illnesses. In difficult and doubtful cases a true statement of these often gives the clue to diagnosis, and even patients themselves are alive to the value set upon an accurate account of their life-ailments. An attack of croupous pneumonia predisposes to recurrence, especially during the three months succeeding the attack; and it may leave behind a predisposition extending far beyond the original disease. Chorea, acute rheumatism, tonsillitis, malarial fevers, and epilepsy tend to recur, as also do the ordinary convulsions of children; but in all these and many other cases it is difficult to estimate the exact part played by derived predisposition, because in all the primary predisposition may be the main agent in the subsequent attacks. In practical medicine it is distinctly recognised that certain diseases predispose to disease, and in their case recurrence is, very properly, jealously guarded against. Pertussis is supposed to predispose to measles, and *vice versâ*. There is distinctly a connexion between chorea, rheumatism, and scarlet fever, and these diseases may follow one another in any order. Again, previous disease may leave behind pathological conditions which remain in abeyance, until excited by causes which the healthy individual could readily withstand. Pertussis often ends, to all appearances, favourably, but afterwards the patients may suffer from severe lung-affections, upon trifling exposure to exciting influences. Caseated or calcified tubercles in the lungs may after a long period of quiescence excite acute phthisis; hepatic mischief followed by collection of gall-stones in the gall-bladder may cause peritonitis and other diseases. Slight complaints are even more marked in their predisposing powers than serious diseases. On the other hand, previous disease sometimes protects individuals and communities; for example, vaccination can save nations from the most terrible of epidemics—small-pox. In the case of scarlet fever, typhus, pertussis, measles, &c., an almost perfect immunity is acquired by those who have already suffered from them. Of course, as with small-pox, no one denies that second attacks of these diseases do occur, but such attacks are wholly exceptional.

13. **Mental and Moral Conditions.**—Bad news may cause sudden death, or, short of this, may interfere with the functions of particular organs. Sudden mental worry may excite dangerous interference with digestion, or start an abnormal cardiac rhythm. Fright has turned the hair white within a few days or hours in healthy persons. Mental and moral shock may check or increase the flow of urine, and, in fact, may affect all the excreting and secreting organs of the economy. Mental overwork may excite cerebral symptoms of a dangerous and even fatal nature, probably dependent upon a general inflammatory hyperæmia. It may also increase the predisposition to tubercular meningitis. Undue or sudden emotional disturbances can excite serious mischief, just as they can predispose to it. Again, the mind is affected by imitative influences; thus a single hysterical patient may arouse in others symptoms almost identical with her own. The subject of the direct influence of the mental and moral state on disease is, however, too wide to be here dwelt upon.

14. **External Physical Conditions.**—These are very numerous as exciting causes of disease. Violent or over-exertion may cause herniæ, hæmorrhages, as from the vessels of the lungs, cerebral congestions, and even ruptures of the valves of the heart, and in one or all of these cases lead directly to death. Over-exertion with the voice may be followed by pharyngitis or laryngitis. Syncope has occurred in the most healthy from violent exertion in hill-climbing, in boat-racing, walking and running matches, &c., acute dilatation of the ventricles probably occurring. In less marked cases an 'irritable heart' may result. Various forms of direct injury are frequent causes of disease.

15. **Cold and Chill.**—Cold carried to excess may prove fatal at once. The influences of severe cold are described under its own heading, and it is only with the diseases excited by cold in the everyday acceptation of these terms that we shall deal here. *See* COLD, Effects of Severe or Extreme.

Cold is the most common cause of disease in temperate climates, especially in the changeable climate of this country. It can excite disease directly, and can affect probably all the organs of the body, causing either disturbed function or organic mischief. Cold, when severe, contracts the vessels; interferes with the circulation, and all vital activity; and in this way may cause death. But it is with moderate degrees of cold we have chiefly to deal. A momentary exposure to a cold draught is as frequent an excitant of disease as general exposure for a long time. A cold draught playing on the cheek may cause facial paralysis, sore-throat, or bronchitis; that is to say, cold applied locally may excite disease in the neighbourhood of its application or in distant organs. It is probable, therefore, that cold may act in several ways: (1) it may interfere with circulation; (2) it may affect the extremities of nerves and excite disease by reflex action; or (3) it may check secretions of the skin, the mucous membranes, or other parts.

We cannot wonder, therefore, that diseases of the throat, larynx, and lungs are frequently excited by cold. Bronchitis and pneumonia are its most common results; and as the young and the old are less capable of enduring cold than adults, its results are, in their case, more frequently fatal. Diarrhœa, renal diseases, congestion of the liver, acute and chronic rheumatism, simple dyspepsia, and a host of other affections, are traceable in many instances only to cold. Predisposition has much to do with the effects of cold: some individuals suffer from one form of disease when exposed to it, others from entirely different affections. In some, 'a common cold' is most evidenced by severe muscular pains and fever, in others by a nasal discharge, in others by headache, and so on. Some persons never suffer from 'cold' without having an attack of herpes labialis; and some are most prone to 'catch cold' whenever the weather suddenly becomes warm. Numerous similar idiosyncrasies might be given. The effects of cold should always be considered in almost all predisposing causes of disease. 'Cold' is a vague term and not thoroughly understood; there is, therefore, all the more reason why, when it comes under consideration in individual cases, its precise effects should be most carefully considered and recorded.

16. **Poisons.**—Poisonous gases are powerful excitants of disease, and so are poisons generally, whether animal, vegetable, or inorganic. They may kill quickly, or excite a disease of long-continued or even permanent nature.

17. **Diet.**—Food and drink may by their abuse excite disease, and gluttony is as certainly an excitant as drunkenness, though this fact is often lost sight of. Excess of food does not refer simply to the quantity taken, but to its quality—its nature, richness, and the times when it is taken. *Excess of food* overloads the stomach, makes calls upon it which it cannot meet, and dyspepsia is the result. Excess of food, if digested, charges the blood with materials not demanded by the economy, and disease of excretory organs or fatty degenerations may thus be excited. *Want of food*, by diminishing the resisting power, also predisposes to disease, such as pneumonia and bronchitis. When the *proper proportions of the elements* of food are neglected, disease results, as *e.g.* scurvy from deficiency of fresh vegetables. Rickets, according to Dr. Cheadle, is due to want of fat, while gout is often provoked by a largely nitrogenous diet, and diabetes by an excessively saccharine one. *Particular foods* will immediately excite violent gastric catarrhs in some individuals, while others can bear them perfectly well. Clotted lumps of casein or starchy foods may irritate the alimentary canal of an infant, as well as, from their indigestibility, afford no nourishment. Many deaths ascribed to 'consumptive bowels' are due to this cause. Putrid food is an active poison. Certain kinds of *fish* are poisonous in themselves, and so may be shell-fish and crustaceans. The Bothriocephalus latus enters the body through the flesh of the pike; and, according to Hutchinson, leprosy is derived from salted fish. Diseased rye produces ergotism, and diseased maize pellagra. Flesh from animals suffering from 'trembles,' is believed to give rise to 'milk sickness'; trichinosis and the common forms of tape-worm result from the ingestion of beef or pork affected with the particular parasite in question; and some vegetable foods laden with salts of lime have been supposed to cause urinary calculi. Water and milk are prolific sources of mischief, through the impurities they so often contain. The drinking-waters of large towns are usually derived from rivers, and filtration is not a sufficient purification; or, if obtained from a purer source, they may become contaminated in transit or storage, so that disease may be excited by their use, especially typhoid fever. Scarlet fever, cholera, and malaria have, according to some, been traced to the same source. Many parasites thus find entrance, *e.g.* the ova of the Tænia solium (developing in the cystic stage), Distoma hæmatobium, Ankylostoma duodenale, Filaria sanguinis hominis, and Guinea-worm. Hydatids may be derived from the same source, or conveyed directly to the food from the nose or fæces of an infected dog. Diarrhœa, dysentery, Oriental boil, and various forms of

metallic poisoning (lead, copper, arsenic, zinc, and mercury) sometimes owe their presence to the minute quantities taken in drinking-water. Goître and cretinism have been attributed to inorganic impurity in water. Alcohol is a most extensive source of disease: it causes, when taken in excess, cerebral, gastric, intestinal, hepatic, and renal affections, and can lower the system so far as to predispose to other diseases. *See* ALCOHOLISM; ENTOZOA; and POISONOUS FOOD.

18. **Epidemic Diseases, Contagion, Malaria, Parasites,** and **Growths** are treated of under separate headings. It is now generally established that the diseases known as the acute specific diseases are mostly direct consequences of some contagium. So among the most common exciting causes of disease we must class the contagia of the several fevers, of syphilis, tubercle, and many others. *See* CONTAGION; PERSONAL HEALTH; and PUBLIC HEALTH.

J. PEARSON IRVINE.
H. MONTAGUE MURRAY.

DISEASE, Classification of.—Various classifications of diseases, or systems of nosology, have been adopted by different writers, but it is beyond the province of this work to discuss these arrangements, neither of which fulfils all that is required, or can be regarded as satisfactory. All that can be done here is to point out the characters upon which the chief divisions of diseases are founded.

The first classification deserving of mention is that into (1) **General** and (2) **Local. General** diseases include those in which the whole system is involved from the commencement, and it comprehends as subdivisions: (*a*) The *acute specific fevers*, and certain other diseases due to the introduction of some special morbific agent into the body from without, or in some instances developed within the system—for example, typhus and typhoid fevers, scarlatina, small-pox, malarial fevers, hydrophobia, syphilis, pyæmia, and septicæmia. (*b*) The so-called *constitutional, cachectic, diathetic*, or *blood-diseases*, some of which seem to depend upon the production of deleterious elements within the system, which are capable of recognition, such as rheumatism and gout; while others are independent of any such obvious pathological causes, but are supposed to be severally associated with a peculiar dyscrasia or diathesis—for instance, cancer, tuberculosis, scurvy, rickets. **Local** diseases are those which primarily affect particular organs or tissues, each being liable to its own peculiar lesions. Thus we have diseases of the lungs, heart, stomach, liver, kidneys, brain, and the other organs; of the mucous membranes, serous or fibro-serous membranes, skin, periosteum, bone, and other structures. This division into general and local diseases is useful within proper limits, but it must be remembered that general maladies are often revealed or accompanied by local lesions, and that complaints which are originally local often more or less speedily set up general disturbance. Moreover, it is still a question whether some maladies are to be regarded as general or local in the first instance. *See* SYMMETRY, IN RELATION TO DISEASE.

Another division of diseases, which applies more particularly to those which are of a local nature, is into (1) **Organic** or **Structural**, and (2) **Functional.** These terms are self-explanatory, the former implying that there is some organic change in the affected part, which we can discover and demonstrate; the latter indicating that there is mere functional disorder, which is independent of any recognisable lesion. That there are structural changes in many affections which are regarded as functional, is, however, highly probable, though our means of observation are not sufficiently powerful to enable us to detect them. In connexion with each organ, a special classification of its individual complaints under one or other of these primary headings is usually adopted, this subdivision depending upon the affections to which the particular organ is liable. As illustrations of functional disorders may be mentioned disturbed action of certain organs, as of the heart, causing palpitation; derangement of the secretory or excretory functions, as in the case of the stomach, liver, or kidneys; and many nervous disorders. Organic diseases are exemplified by inflammation and its consequences; alterations in growth and development; degenerations; malformations; and new-growths. In this work it has not been deemed advisable to describe the diseases of the several organs according to any definite scientific arrangement, but in some cases an alphabetical order has been adopted, while in others individual writers have had free scope to classify the affections of a particular organ according to their own judgment.

Again, diseases may be classified according to their causation and mode of origin. Thus they are divided into: (1) **Hereditary,** or those which are transmitted either directly from parents to children, or indirectly, as the result of a family taint; and (2) **Acquired,** or those which are developed anew in persons free from hereditary taint. When a morbid condition exists at birth, it is said to be **Congenital.** Other divisions, founded on an ætiological basis, are into: (1) **Contagious** or **Infectious,** and (2) **Non-contagious;** and into (1) **Specific,** or those diseases which are due to a specific cause, and (2) **Non-specific.**

There are other classifications of diseases, which need only be mentioned here. Thus, according to their intensity and duration, they are said to be: (1) **Acute;** (2) **Subacute;** or (3) **Chronic.** Another arrangement, founded on their mode of progress, is into: (1) **Continuous**; (2) **Periodical**, or affections which come on at more or less definite intervals; (3) **Paroxysmal**, or those which are characterised by sudden or acute paroxysms; and (4) **Recurrent**, or diseases which tend to recur. Lastly, according to their mode of distribution amongst communities or in districts, complaints are said to be: (1) **Sporadic**; (2) **Epidemic**; (3) **Endemic**; and (4) **Pandemic**. The meanings of these terms are defined under their several headings, but they are sufficiently familiar as indicating the mode of distribution of the diseases to which they respectively belong.

With regard to the classification of diseases which is likely to be permanently adopted in the future for general use, it is probable that this will be founded on a pathological basis, and that, as our knowledge of morbid conditions and processes becomes more extensive, accurate, and definite, it may become possible to establish a system of nosology which will be both scientific and practically useful.

FREDERICK T. ROBERTS.

DISEASE, Diagnosis of (διὰ, apart; and γινώσκω, I know).—SYNON.: Fr. *Diagnose*; Ger. *Diagnose*.

DEFINITION.—Diagnosis is the art of recognising the presence of disease, and of distinguishing different diseases from each other. The term is also applied to the result obtained.

GENERAL CONSIDERATIONS.—The *general principles* only of diagnosis will be here discussed. *Special diagnoses* will be treated of in connexion with the several diseases to which they have reference.

In many respects diagnosis is a subject of great interest and importance. First, in a scientific point of view, it is essential that all knowledge should be accurate. Secondly, accuracy of diagnosis, founded upon a sound pathology, enables us to frame a scientific classification of disease in its diverse forms. Thirdly, it is by an accurate determination of the nature of the disease which may be present in any given case that we are able to anticipate its course, and to employ the right kind of remedies in its treatment. It is imperfection of diagnosis which leads in many instances to an under-estimate of the value of therapeutical agents; for when the nature of a disease is mistaken we are led to employ improper and unsuitable remedies, the failure of which is then erroneously attributed to the inefficiency of the agents, and not to the unfitness of the treatment employed. If our diagnosis had been correct or complete, the remedy employed would more often have had the desired effect.

In order to arrive at a diagnosis we must study the phenomena or characters of each individual case, and then trace its connexion with those groups of symptoms which have been previously recognised and described as belonging to special or distinct classes of disease. Assuming that the classification has been already made, we proceed to deal with the means which enable us to identify each individual case, and to connect it with previously classified forms of disease.

MEANS OF DIAGNOSIS.—To obtain accuracy in diagnosis we must be prepared with a knowledge of the several forms and the varieties which disease assumes; we must be familiar also with the functions and structure of the several organs of the body in health. It is by observing and comparing the changes wrought by disease in these functions and structures that we are enabled to discover the presence of, and to determine the nature of, the morbid process going on. In forming, then, a diagnosis in any particular case, the physician must, as far as possible, keep in view the real or the ideal condition of the patient in a state of health. He must endeavour to place him in as natural a position as may be, and as little disturbed by the presence of his attendant, or by external circumstances, as possible. The physician must then obtain a history from the patient himself or from others of the incidence of the disease; and having done this he must proceed to investigate for himself the condition of the patient.

1. *Previous history of the patient.*—The history implies of course a statement of the age and sex of the patient, as of his home and his employment—each of which may have a special relation to disease. It should also include an inquiry into the antecedent generations of the patient, and how far he may have any proclivity to congenital disease or malformation. This inquiry should have reference to both positive and negative facts. It should extend not only to the previous existence of disease in the family, but also to the absence of particular diseases or types of constitution. The patient's history should include a statement as regards the diseases and injuries from which he may previously have suffered; the remedies used for them; and the climatic and other influences to which he has been exposed. Nor must the physician neglect to ascertain the history of any children that the patient may have had, as the nature of disease from which the offspring have suffered in many instances throws light upon the health of the parent.

2. *History of present illness.*—The history of the present illness should include the determination of the date of its commencement; its probable cause; its earliest phenomena and its progress as influenced by external circumstances, including treatment.

3. *The present condition of the patient.*—Here we have to deal with two classes of phenomena; namely (*a*) those feelings or facts of self-consciousness which the patient describes to us—*subjective phenomena*; and

(*b*) those signs which we ourselves observe—*objective phenomena.*

(*a*) *Subjective phenomena.*—The patient describes to us his feelings—as of strength or weakness, of numbness, tingling or pain, of wakefulness or wandering; he can tell of affections of vision, of hearing, of smell, or of taste; of breathlessness, cough, palpitation, or of feelings of sinking or faintness; of difficulty of swallowing, thirst, loss of appetite, nausea or sickness, or various sensations and actions connected with the abdomen; of feelings associated with the genito-urinary organs, such as pain or difficulty in passing water; of cramps, spasms, or other alterations of sensation or motility; or of disturbances of sensibility and activity, &c. Each of these signs of deviation from health will have its own value and significance. The physician must at the same time carefully note how far the condition of the patient is in accordance with his statements, and whether there may not be present some reason or cause for concealment or for exaggeration.

(*b*) *Objective phenomena.*—In studying the objective phenomena connected with disease, the physician makes use of his special senses, assisted by the several instruments with which modern science has provided him.

First, in matters of *eyesight*, he sees the general aspect and expression of the patient, which will include the colour of the skin (such as may result from the fulness or emptiness of the blood-vessels, from the yellowness caused by jaundice, from the blueness of cyanosis, or from pigmentation, &c.); the presence and character of cutaneous eruptions (especially in the exanthemata); the expression proper, such as that of ease or suffering, and of depression or excitement; the conditions of obesity and plethora, or of wasting and bloodlessness. He will also observe the position of the patient—how he lies, or sits, or stands; how he breathes; the appearance of the eyes, the tongue, &c. Further, the sense of sight will be employed in determining conditions of a local or less general nature. Observation must be made of the size, the shape, and movements of parts, and of their expansion or contraction. With the aid of special instruments, such as the ophthalmoscope, the laryngoscope, the cystoscope, the various specula, sounds, &c., the physician will be able to examine parts of the body of the patient beyond the reach of the unassisted eye. The chest-measurer or the stethometer will render more exact the information already obtained by the eye and hand as to the size and mobility of parts. The use of each of the several instruments above mentioned, as a means of diagnosis, will be found described under the heads of their respective names, or in the article on Physical Examination.

The sense of *hearing* tells of the character of the breathing, the voice and speech of the patient, including cough, hoarseness or aphonia, 'aphasia,' &c. But the ear is especially applied to the study by auscultation of the sounds produced in connexion with the heart, the lungs, and other organs. The signs thus elicited will be found fully described elsewhere.

The sense of *touch*, or feeling, will communicate a knowledge of the temperature, of moisture or dryness, of size, shape, elevation or depression, of smoothness or roughness, of the pulse or pulsation, vibration, fremitus, of extent of movement, resistance, softness or hardness, and of fluctuation. The accuracy of the results of these observations by touch may be tested by the use of the thermometer, the calipers, and the tape-measure.

The sense of *smell* aids diagnosis in certain cases. The general odour of the patient may be observed in small-pox, in rheumatism, and some wasting diseases (such as phthisis), and in syphilis; and the odour of particular parts and secretions, as the urine in diabetes, the fæces in jaundice, &c., and in cases of the use of certain drugs, or in poisoning. Information is also afforded by the odour of certain discharges, as in ozæna, leucorrhœa, cancer, &c.

The sense of *taste* is seldom employed in clinical investigation, but the physician may make use of the patient's taste, as in tasting the urine in diabetes.

Further aids in diagnosis.—Having thus summarily described the employment of the special senses in diagnosis, and given examples of their use, we may briefly mention some other agencies of more general application. The acuteness of the patient's sense of touch may be determined by the æsthesiometer. The capacity of the lungs may be measured by the spirometer; the strength of muscles by the dynamometer; the contractility of muscles by galvanism; and the force and character of the pulse are determined by the sphygmograph. Constant use is found for the microscope, the test-tube, the spectroscope, the endoscope, and polariscope, which aid in determining the character of the various secretions or morbid products that require to be submitted to investigation. The result of treatment may also be mentioned as an aid to diagnosis, as, for example, when an indurated sore yields to the use of mercury. Again, the knowledge that a person has been in a malarious district enables us to decide on the intermittent nature of certain symptoms that may be present. In some cases it may be necessary to render a patient insensible by anæsthetics, with a view to making a complete examination, or in investigating feigned diseases. The administration of small doses of charcoal has been suggested as a means of determining the presence of a passage through the bowels when more or less obstruction exists.

Such, then, are the means used for taking note of those deviations from health which occur in the several functions and structures of the body, and which constitute what are known as the *symptoms and signs of disease*; these are terms which will be found more specially treated of under the heads, DISEASE, Symptoms and Signs of; and PHYSICAL EXAMINATION.

THE DIFFICULTIES OF DIAGNOSIS.—It need scarcely be said here that the practice of diagnosis is not free from great difficulties. We know how hard it is to obtain in ordinary daily life a reliable account or description of any past or present event. There must be still greater difficulty in obtaining an accurate medical history of a patient's case. He has to tell of facts of which practically he may know much, but scientifically very little. He may be forgetful or ignorant on points about which we most need to be informed. He may be inclined to exaggerate or to suppress facts of material import. Nor are the difficulties less in regard to the *objective phenomena* with which we have to deal. The symptoms of a disease are not always so clear and definite as to mark its nature—that is, to be *pathognomonic.* They are more often slight, undefined, obscure, and to be found with difficulty. The symptoms of one disease may very closely resemble those of another, whilst those of the same disease will vary at different stages, and in different individuals. Again, the symptoms of a disease may be complicated by the co-existence of those of another disease; whilst a symptom sufficiently striking in itself may be common to, and present in, several different diseases. We need only mention, for example, feverishness, pain, cough, breathlessness, and blood-spitting.

These are some of the difficulties which he who has to study the operation of disease in life, has to contend with. He must come prepared for the duty with a knowledge, as we have already said, of the body, its structure and its functions in health, and with a knowledge, too, of those combinations of morbid actions which constitute special forms of disease. For, as regards this latter knowledge, all the observations made would remain as isolated phenomena if they could not in each case be grouped as constituting distinct diseases.

We have thus indicated the difficulties of obtaining accurate knowledge as regards both the subjective and objective phenomena. The difficulties are not less when the exercise of the intellectual and reasoning faculties is called upon to analyse, to compare, and to group these phenomena.

The physician may commence his inquiry by tracing up the history of the case and its several incidents, a method which is called the *synthetical*; or he may commence by ascertaining the present condition of the patient, and going as it were backwards in his inquiry—a method which is known as the *analytical.* As a general rule, both methods are combined in the practice of diagnosis.

Observers can sometimes arrive at a *direct diagnosis*, aided by the presence of some characteristic symptom or sign of disease. When diseases which are essentially different have symptoms more or less common to both, the physician will have to institute a *comparison* between them, until he finds sufficient evidence, in the presence or in the absence of some distinctive symptom or sign, to satisfy him as to the nature of the disease which is present. By being able thus to trace the absence or the presence of a given symptom, he may be able to *exclude* the possibility of the existence of one or other of the diseases under investigation. These modes of investigation will be found fully illustrated in the diagnosis of the several diseases described throughout this work.

In conclusion, it must be remembered that these investigations, which call for the exercise of the highest mental faculties, should be conducted without prejudice and without haste. We should never be ready to accept as clear that which is obscure, as established that which is open to question; above all, we should remember that, though to err is human, it is our duty to endeavour to ascertain in each and every case, before commencing its treatment, what its real nature is, as far as it may be possible for us to do so. It cannot be too often repeated that the application of a right remedy depends on an accurate diagnosis, and that the prevention and the cure of disease are the aims and ultimate objects of our science.

RICHARD QUAIN.

DISEASE, Duration of.—The duration of a disease signifies the period which elapses between its onset and its termination, in whatever way this may take place. In some instances disease can hardly be said to have any duration, a sudden lesion occurring, which instantaneously, or in a very short time, destroys life; under such circumstances, however, some previous disease has usually existed, though perhaps without giving any clinical evidence of its presence, which determines the occurrence of the sudden event. This may be illustrated by some cases of apoplexy, and of rupture of the heart or of an aneurysm. Most affections, as regards their duration, come under one of the three categories already referred to under the CLASSIFICATION OF DISEASE—namely, *acute*, *subacute*, or *chronic*; but it does not serve any useful purpose to fix upon any definite limit of time as specially expressed by these several terms. *See* ACUTE; and CHRONIC.

Acute diseases are of limited duration, and in many of them this is remarkably uniform on the whole, as may be illustrated by the acute specific fevers and acute idiopathic pneumonia. Even in such affections, however, there are deviations from the ordinary course, instances occurring in which the duration is longer or shorter than that usually observed, and this fact depends on various circumstances, of which the most obvious are the intensity of the disease in any particular case, the previous condition and surrounding circumstances of the patient, the occurrence of complications, and the treatment adopted. Complaints which are *sub-acute* as regards their duration may be exemplified by many cases of whooping cough and chorea, and by some cases of pleurisy, phthisis, pneumonia, gastric or enteric catarrh, and certain skin affections. A large number of diseases are *chronic* in their duration, and many of these when once established become permanent, whilst others are ultimately capable of being cured. As illustrations may be mentioned organic diseases of the heart, most cases of phthisis, cirrhosis of the liver, chronic Bright's disease, dyspepsia, many skin affections, and also morbid growths in various structures.

Some complaints, as regards their duration, can only belong to one or other of the groups just indicated, but a considerable proportion may in different cases be either acute, sub-acute, or chronic. Again, it must be borne in mind that a disease may be acute or even sudden in its origin, but afterwards may subside into a chronic malady. Certain affections are chronic as regards their entire duration, but are characterised by the occurrence at regular or irregular intervals of acute or even sudden attacks, lasting a more or less definite time, which course of events is exemplified by cases of ague, epilepsy, and asthma.

Frederick T. Roberts.

DISEASE, Germs of.—*See* Germs of Disease.

DISEASE, Prognosis of (πρὸ, before; and γινώσκω, I know).—Synon.: Fr. *Pronostic*; Ger. *Prognose.*

Definition.—Prognosis is the art of forecasting the progress and termination of any given case of disease. The term is also applied to the foreknowledge thus obtained.

General Considerations.—It is a matter of interest and often of great importance to be able to indicate with precision how a case of disease or injury will be likely to advance and terminate. This question must be always present to the physician's mind; and it can rarely be absent from that of the patient and of those who are interested in his well-being. It can thus be easily seen how much depends upon the answer of the physician to the questions constantly proposed to him, How long is this illness likely to last? How is it likely to terminate? If in recovery, will the recovery be complete or partial? If in death, when and how?

Grounds of Prognosis.—The knowledge which can give trustworthy answers to such questions as the preceding must be founded upon an accurate diagnosis of the nature of the disease from which the individual is suffering; upon the capability of remedies to control it; and, lastly, upon an estimate of the constitutional and vital powers of the patient.

First, as regards the *nature of the disease.* Some diseases which are mild in their nature run a definite course and end favourably: take, for example, a simple catarrh. Others commence with great intensity, and come to a favourable or unfavourable termination very rapidly: for instance, Asiatic cholera, of which many of the subjects die in less than twenty-four hours from the time of their first becoming manifestly ill. A third group, such as typhus, typhoid fever, and certain of the exanthemata, run a longer and more defined course, seldom terminating in death except after the lapse of many days, nor in recovery except after a period of weeks. Another class of maladies, chronic in character, rarely acute, such as tuberculous diseases of the lungs, render the patient more or less an invalid so long as he lives, and generally end fatally. The like observation will apply to the so-called malignant diseases.

Secondly, the *intensity of the particular attack* affords further grounds for prognosticating the result. Thus, in a fever, great prostration, high temperature, and rapid pulse, indicative of the severity of the disease, must lead to the formation of an unfavourable prognosis; just as great debility and wasting, with disturbance of the nutritive functions generally, would indicate a like result in chronic diseases.

Thirdly, with regard to local diseases or complications, whatever the nature of the disease may be, the *organ affected* must form an important element in prognosis. Thus disease of the brain, or of the heart, or of the lungs, or, in a lesser degree, of other viscera, must, even when not specially severe, be looked upon as affording grounds for anxiety, from a prognostic point of view.

Fourthly, as regards the *constitution, age, and sex of the patient*, it may be safely anticipated that in a patient with a good constitution the prognosis will be more favourable than in a person with a feeble or broken-down constitution. Persons whose vital powers are unimpaired will resist disease, and recover under circumstances which would be fatal to other individuals, in whom, on the one hand, plethoric habits may predispose to acute and rapid changes, or who, on the other hand, by degeneration of tissues or by the existence of chronic disease may be rendered liable to succumb, and that rapidly, to morbid influences which healthier textures could resist and overcome.

Disease is badly borne by the very young and the very old. In very young children disease rapidly runs its course, favourably or unfavourably. The aged have little power of reaction or of resistance; and disease in them, though less pronounced, more frequently ends unfavourably. In middle life, disease may be expected to assume an acute or sthenic form.

As a rule, sex has little influence on the prognosis of disease, except that usually diseases of equal severity are more amenable to treatment in females than in males. Nervous symptoms are, however, more easily developed in women, exaggerating a condition that might not otherwise be unfavourable. Menstruation, pregnancy, parturition, and lactation have all a certain amount of influence, sometimes favourable and sometimes the reverse, on disease in the female.

Fifthly, with respect to *treatment*: a more or less favourable prognosis may be founded upon the fact that the patient can enjoy all the advantages afforded by rest, diet, change of climate, &c., which may not be available under other circumstances for like cases. It is well known that there are some remedies which have a specific effect upon certain diseases, as quinine upon intermittent fever; mercury in some manifestations of syphilis; iodide of potassium in certain stages of the same disease; and colchicum in gout. In such cases a much more favourable prognosis can, of course, be given than in those for which no such specific remedies are known to exist. Experience, however, tells us that favourable results follow in many other cases in which suitable though not actually specific remedies can be applied.

Taking into consideration, then, the above conditions—the nature, the intensity, and the seat of the disease; the constitution, the resisting power, the age, and the sex of the patient; and the possibility of applying suitable and efficient remedies—we are able, in a large number of cases, to arrive at an accurate conclusion as to what the course and result of a disease will be.

Difficulties of Prognosis.—Still, to arrive at an accurate prognosis is often most difficult. Disease is not always identical in its character, nor definite in its progress or results. The constitutions of individuals vary, and it is often very difficult to measure their powers of resistance. Remedies, too, vary in their action and their operation; and sometimes we are deceived in the best-founded conclusion as to the results that they can accomplish. There are few physicians who cannot recount errors of prognosis made by themselves or by their colleagues. Many persons now live who were doomed to die; and many persons have died whose death was not anticipated. It is the duty of the physician, when asked for his opinion, to state it honestly, but with great discretion, and in general with as much hope as is fairly admissible. He must be guarded as to the manner in which his opinion is communicated to the patient, for there are many individuals whose temperament is such that the progress of their disease would be greatly influenced for good or for evil by the expression of a favourable or of an unfavourable opinion. At the same time, the physician must avoid deceit; and if there be risk or danger in communicating an unfavourable prognosis to the patient, he must at least communicate it to some judicious individual amongst the patient's friends. Altogether, too much caution cannot be exercised in stating, in any obscure case, what its progress and result will be. There are many cases in which the medical attendant will be justified in replying that he is a physician, and not a prophet. He cannot always foretell results, his aim and object ever being to mitigate the patient's suffering, to prolong life, and to cure the disease if possible; full often to profess or to do more than this is beyond his art.

Richard Quain.

DISEASE, Symptoms and Signs of. When disease affects any of the functions or structures of the body it produces certain altered actions or changes, which, when observed during life, become evidences of its presence and often of its nature, and which then are called the symptoms and signs of disease.

The terms *symptom* and *sign* are often used synonymously, though the derivations of the words are by no means the same. *Symptom*, according to its derivation (σύμπτωμα = a coincidence), means simply a *coincidence*; that is to say, it coincides with the presence of certain phenomena. The term *sign* (from *signum*) is more distinctive, and seems more directly to point to some special or peculiar condition. Recently, however, an attempt has been made to give a more special meaning to these terms. *Symptom*, more especially if it be characterised by the prefix *vital*, is intended to refer to modifications of functions, or to such *subjective* phenomena as we can learn from the patient's account of his feelings. On the other hand, the term *sign*, more markedly with the prefix *physical*, indicates those morbid changes which are *objective*, or may be recognised by the senses of the physician, assisted by other appliances.

It would possibly be well if the meanings of the words—symptoms and signs of disease—as above stated, were to come into general use; but there are many difficulties in the way. For example, if the ear be applied to the chest in the case of incompetence of the aortic valves, we hear a murmur, and we say that there are 'physical signs' of aortic valve imperfection; but the locomotive pulse, and its peculiar beat, would by many be called a 'symptom' of incompetence of the aortic valves. It is therefore extremely difficult to draw the distinction between the terms 'symptom' and 'sign.'

By whatever name these phenomena may be called, we must rely upon them as the chief means by which we are enabled to form our diagnosis. The more accurate and complete our knowledge of the functions of the body and of its component parts, and the more capable we are of interpreting, with all the completeness possible, the changes produced by disease, the more accurate will be our diagnosis as to its presence and its nature. How these phenomena may be best observed will be found discussed under the articles on DISEASE, Diagnosis of; and PHYSICAL EXAMINATION. RICHARD QUAIN.

DISEASE, Terminations of.—The terminations of a disease must be regarded both from a *pathological* and from a *clinical* point of view.

Each *pathological* process or condition has modes of ending peculiar to itself, but it is beyond the province of this article to discuss these at any length, and one or two illustrations must suffice. Thus inflammation may terminate by resolution; by the formation of different effusions or exudations; or by causing suppuration, softening, induration, ulceration, or gangrene. Fever, if it end favourably, may terminate by crisis, lysis, or a combination of these modes, or in an irregular fashion. An effusion of blood may remain, more or less altered; may become organised; may soften and undergo a puriform change; may form a cyst; or may be altogether absorbed.

The *clinical* terminations of diseases are highly important, and demand more consideration. In the first place, a disease frequently terminates in the *death* of the patient. This event may take place suddenly or very rapidly, from the occurrence of some serious lesion, or of grave functional disorder of an organ essential for carrying on the phenomena which constitute life. In other cases death is the termination of a more or less acute illness, either affecting a person previously in the enjoyment of good health; or, what is not uncommon, being the consummation of a chronic malady, which has existed for a longer or shorter period. In still other instances, death is a slow and chronic process, the patient gradually sinking, several causes and morbid conditions often ultimately contributing to the fatal event. The modes in which death occurs are described elsewhere, and therefore need not be discussed in this article. *See* DEATH, Modes of.

In the next place, a large proportion of cases of disease end in *complete* and *entire recovery*, the patients being restored to their previous state of health, and no organic mischief remaining. This result may be expected in most of the ailments or functional disorders which are of such common occurrence, provided proper treatment is carried out. Again, the great majority of cases of acute disease terminate in complete recovery, taking them in the mass, though several affections of this class, when they do not prove fatal, are liable to leave behind more or less serious deterioration of the general health, or even actual organic disease. In this class of cases, when recovery does ensue, it is usually only after a more or less prolonged period of convalescence. Chronic complaints, if they are of a structural nature, cannot in most instances end in complete recovery, although to all appearance the patient may often be quite restored to health. Even in these cases, however, an actual cure may sometimes be effected, and that after a disease has had a prolonged duration. This is illustrated by several chronic skin-affections, syphilis, and chronic inflammation of mucous surfaces. Or it may happen that the patient recovers perfectly, only with the destruction of some structure which is not essential to life, such as a group of lymphatic glands.

Thirdly, *partial* or *incomplete recovery* is a very common mode of termination. This is observed in many cases of acute disease, where either the patient remains permanently in a state of general ill-health, without any actual structural lesion being discoverable; or some positive organic affection has been established, of which phthisis remaining after acute pneumonia, or cardiac disease following acute rheumatism, afford apt illustrations. An attack of an acute malady may also serve to bring out some latent constitutional predisposition; or may leave the patient in such a condition that certain so-called constitutional maladies are readily originated from slight causes. Partial recovery, amounting often to very marked improvement, may take place in many serious diseases of a chronic nature. This is illustrated by numerous cases of pulmonary consumption, in which disease great improvement is often observed, not only as regards the symptoms, but also in the local lesions, so much so that patients not uncommonly regard themselves as cured. Again, there are some complaints in which apparent recovery is brought about, but a tendency to recurrence remains, either without any obvious reason or from slight causes. Such affections are exemplified by ague, asthma, neuralgia, intestinal catarrh, bronchitis, and certain skin-diseases. As instances of incomplete recovery may be also mentioned the cure of some prominent symptom or symptoms, while the disease which originates these phenomena continues unaltered. Thus, it may be possible to get rid of ascites, which the patient regards as the disease from which he suffers, while cirrhosis of the liver, upon which the ascites depends, is a permanent condition; extensive dropsy and other symptoms associated with cardiac disease may also be got rid of, while the organic mischief still remains. Sudden lesions may terminate in partial recovery. For instance, a case in which a sudden hæmorrhage into the brain has occurred, attended with marked apoplectic and paralytic symptoms, not uncommonly improves remarkably in course of time, the clot being more or less absorbed. Some complaints, which are usually sudden in their onset, may apparently be recovered from completely, but sometimes set up conditions which ultimately lead to permanent disease. Thus the passage of a gall-stone or of a renal calculus may excite such irritation as to cause an inflammatory process to be set up, which may induce permanent mischief, such as closure of the bile-duct or of the ureter in the several instances, and the effects may not be perceptible until a considerable interval has elapsed.

Lastly, it must be remarked that some affections can hardly be said to have any termination. They continue during the life of the individual, perhaps interfering but little or not at all with the health, or at all events not in any way contributing to the death of the patient, when that event does happen. This applies to many of the ailments from which people suffer; as well as to many chronic organic diseases not in themselves serious or giving rise to any important symptoms, and not implicating structures essential to life.

Frederick T. Roberts.

DISEASE, Treatment of.—This term has reference to the means by which disease may be prevented—*prophylactic* or *preventive* treatment; or its effects counteracted when it occurs—*remedial* or *curative* treatment.

1. **Preventive Treatment** will be found discussed under the heads — Contagion; Climate; Disease, Causes of; Disinfection; Malaria; Personal Health; Public Health; Vaccination, &c.; as well as in the several articles treating of special diseases. It is therefore unnecessary to say more upon the subject in this place.

2. **Curative Treatment.**— Bearing in mind that disease is a deviation from health in the functions or component materials of the body, it must be remembered that there is in organised bodies a tendency to maintain their healthy function and structure, and in case of disease or injury to resume it. This is especially manifest in the lower types of animals, many of which when mutilated are capable of resuming more or less completely their original form, to the extent even of the restoration of lost parts. In man and the higher animals this power of complete restoration is confined to the elementary cells and least complex structures of which the body consists; the more complex tissues are not reproduced, nor are lost parts restored. There is, however, in man, as in all organised beings, a tendency to rectify deviations from health, and to restore the organisation to its normal condition. To remove or subdue the causes of disease, and to aid this restorative power in tho establishment of healthy function and structure, is for the cure of disease the most philosophical indication that can be adopted. But our knowledge of disease and of remedial agents is not sufficient to enable us always to carry out these principles. As the treatment of disease has been directed sometimes to the one object and sometimes to the other, frequently to neither, it has given origin to a great variety of systems or methods of practice. Thus in the earliest history of the healing art, means the most diverse were used for the relief of suffering. Sometimes the suffering or the disease yielded whilst these means were being employed; and it was concluded, on very insufficient grounds, that these agents had 'cured' the disease. Persons who had felt, as they supposed, the beneficial effects of these particular remedies, communicated them to others as the result of their experience; and thus was established what has been known in Medicine as—

Empiricism.—This mode of practice has its advantages and its disadvantages. When aided by accurate knowledge and discrimination it often leads to satisfactory results; and many remedies suggested by experience, and that alone, are now found to be in accord with our more advanced scientific knowledge; take, for example, the use of mercury in syphilis, which, though long used empirically, is now known to act by its control over the nutrition of young cellular growths. So also with respect to quinine and other remedies of now established usefulness. On the other hand, mere empiricism, when vaguely applied, taints and damages to this day the treatment of disease. It is this practice which, for example, suggests opium to quiet a cough or a colic, without reference to the cause of the one or the other, and when an expectorant or a purgative would have been the suitable remedy; and it is this empiricism which does such harm in the hands of amateur practitioners, leading them to recommend for the relief of symptoms, remedies which they supposed had relieved like symptoms in other cases, however different the real nature or causes of these symptoms may have been.

Rational treatment.—On the other hand, modern science endeavours to take cognisance of the nature of disease, and also of the specific action of remedies; it seeks to counteract the operation of the one by the influence of the other. This constitutes the rational treatment of disease. To extend this system should be the object of the scientific practitioner. On the one side, it is his duty to study the nature of disease itself, its causes, and their effects; on the other, to study the action of various agents on the living body in health and in disease; and, if possible, to trace how far the one is capable of combating and subduing the other. This study of scientific therapeutics is of comparatively recent date, and is now pursued with great zeal. The results already arrived at are alike satisfactory and encouraging. As rational treatment becomes more firmly established, scientific medicine will take a more elevated and nobler position. The modes or methods by which the two great principles just alluded to, the foundations as they are of the healing art, have been applied are extremely various, and, although these different methods may be traced to the one or to the other, they have received distinctive names, according as they are marked by some special characteristic. A few of these modes of treatment may be briefly enumerated.

1. *Expectant treatment* is founded on the principle that the restorative power of nature should be allowed entire freedom of action, the practitioner neither assisting nor interfering with its operation.

2. What is called *homœopathic treatment* would by some persons be included under the preceding head. It proposes to treat disease by giving in infinitesimal doses substances that are supposed to be capable of producing a diseased condition like that which they are intended to cure. It may be described in the words of Molière, who wrote long before Hahnemann, the inventor of homœopathy, as *l'art d'amuser le malade pendant que la nature guérit.* There is no doubt that in this and in similar methods of treatment, the imagination plays an active and useful part.

3. *Palliative treatment* consists simply in the adoption of means which are calculated to soothe, and to lessen suffering, and thereby to prolong life when the cure of disease is not possible.

4. *Stimulant treatment* is founded on a doctrine which regards most forms of disease as associated with or dependent on a lowered state of the vital powers, and which teaches that in such cases the free use of stimulants is the practice most to be relied on. *See* STIMULANTS.

5. *Antiphlogistic treatment* is the opposite of the preceding. It recognises in many forms of disease increased nervous excitement and vascular fulness, which are to be remedied by depressing agencies, such as low diet, bleeding, purgation, &c. *See* BLOOD, Abstraction of; and DEPLETION.

6. *Purgative, diaphoretic,* or otherwise *eliminative* treatment aims at removing by the intestinal mucous membrane, by the skin, or by the secreting glands, respectively, certain morbid matters; and thus allowing the restorative power of the system to operate more efficiently. *See* PURGATIVES, &c.

7. The *Water cure*, including baths, acts partly on the principle of elimination, partly by exerting a tonic influence. *See* BATHS; and HYDRO-THERAPEUTICS.

8. *Revulsive treatment* acts by producing counter-irritation by means of blisters, setons, issues, and the like. *See* COUNTER-IRRITANTS; REVULSENTS, &c.

9. *Antiseptic treatment* aims at destroying the germs of disease, whether on the surface of, or within, the body. *See* ANTISEPTIC TREATMENT; and DISINFECTION.

10. *Dietetic treatment* constitutes a greater or less portion of all modes of treatment. It implies a reference to the kind of food which is adapted to the circumstances in which the patient is placed, and which is suitable in the disease from which he is suffering. *See* DIET.

11. The treatment by *climate* operates more or less by removing the patient beyond the region of noxious influences, and placing him in circumstances which promote healthy action of the several functions.

It is well known that under these several and varied modes of treatment disease may yield and patients may get well. Hence it has been said that, as different means are made use of to obtain a single result, the treatment of disease can never be absolutely scientific. Phthisis is pointed to, for example, as a disease which one person seeks to relieve by cod-liver oil, another by climate, a third by tonics, a fourth by sedatives, a fifth by attention to the digestive organs, and a sixth by counter-irritation. We need scarcely say that the disease bearing the name of phthisis is an aggregate of phenomena or conditions, the relief of any one of which may lead to the amelioration of the others. Thus the general health might be improved by climate, and with it all the other symptoms. Cod-liver oil, with remedies calculated to improve the digestion, may lead to healthy nutrition, and thus to a mitigation of all the symptoms. The like remark applies to the other agencies mentioned. The treatment of disease must not, then, be condemned as unscientific because it cannot remedy a variety of morbid states by a single agent, but would aim, on still strictly scientific principles, by different agencies to overcome disease, the effects of which are manifested in different forms.

In conclusion, it may be repeated that the end and aim of the practitioner should be, if possible, firstly, to discover the cause or causes on which the disease depends, and to remove or counteract them if practicable; and, secondly, to endeavour, by every available means, to restore to health the functions of the body, and with that object to guide and assist Nature, but never to thwart her operations. RICHARD QUAIN.

DISEASES, Types and Varieties of.—In the case of many diseases more or less distinct *varieties* are recognised, which in some instances constitute well-defined *types.* It is important to understand the precise significance of these terms in different cases.

In the first place the varieties of a particular affection may be founded upon diversities observed in its *clinical history.* Thus, according to the intensity of the symptoms and their duration, a large number of complaints are, as has already been pointed out, divided into acute, sub-acute, and chronic varieties. Again, many diseases, while presenting in the majority of cases a certain group of symptoms, upon which their general clinical description is founded, exhibit striking differences in the exact nature of the phenomena observed, as well as in their gravity, when the mass of cases is taken into account, and on these differences *varieties* or *types* are founded. This is well-exemplified by some of the acute specific fevers, such as typhoid fever, scarlatina, measles, and small-pox. Of these affections several varieties are described, dependent upon the severity of the symptoms, the nature of those which are most prominent, or the characters of the eruption.

In the next place, the classification of a disease into varieties may be founded upon a *pathological* basis. For instance, pulmonary phthisis may, in the writer's opinion, arise from different morbid processes, and many attempts have been made to arrange the cases of this disease into corresponding groups. Illustrations of these pathological varieties are also found in the different forms of cancer; in the varieties of pneumonia, of laryngitis, and of fatty disease of the heart; and in the classification of serous inflammations according to their morbid products, such as fibrinous, serous, purulent, &c. Again, such a pathological condition as dropsy or fever may be divided into varieties. Thus dropsy is arranged according to its situation and distribution, as anasarca, ascites, &c.; or according to its pathological cause, whether cardiac, pulmonary, hepatic, &c. Fever is recognised as having several important types, founded upon its intensity, its course, and the exact nature of the phenomena accompanying the pyrexial state.

Another division of a disease into varieties is *ætiological*, the cases being grouped according to their causation, either the immediate pathological or the more remote exciting causes being employed as the basis of division. Thus we have the different forms of meningitis (simple, tubercular, rheumatic, &c.); the ætiological varieties of pleurisy or peritonitis (idiopathic, traumatic, perforative, tubercular, secondary, &c.); those of joint-inflammation (simple, rheumatic, gouty, scrofulous, &c.); or those of intestinal obstruction. Ætiological varieties are often at the same time characterised by differences in the pathological results and products.

Lastly, it must be mentioned that sometimes a certain *group of symptoms* is summed up for convenience under some single term, which symptoms really depend upon very different morbid conditions and causes; and therefore it often becomes necessary to classify affections thus named into varieties. Dyspepsia, neuralgia, apoplexy, epilepsy, and paralysis will afford illustrations of such an arrangement.

FREDERICK T. ROBERTS.

DISINFECTION.—SYNON.: Fr. *Désinfection*; Ger. *Desinficiren.*

DEFINITION.—Disinfection, in the proper sense of the term, means any process by which the contagium of a given disease may be destroyed or be rendered inert.

Disinfectants, however, are used in practice for several objects, and in consequence the term has often been vaguely applied to the use of heat or chemical means for preventing the generation or for the destruction of noxious agents, whether products of specific disease or not. In this vague and erroneous sense disinfectants have been confounded with *deodorants*, which merely cover or destroy offensive odours without affecting the contagia; and with *antiseptics*, which 'are fatal to the growth and multiplication of microzymes.' Following the line indicated by the late Dr. Baxter in his valuable report on an experimental study of certain disinfectants, it is necessary to distinguish—

1. The true meaning of the word—that of acting on the specific poisons of communicable diseases in such a way as prevents their spreading.

2. That of acting upon organic substances in such a way as renders them less liable to undergo molecular change and decomposition, whether spontaneously or under the influence of catalytic agents, as in the case of emulsin upon amygdalin; or under the influence of living organisms, such as are connected with fermentation and putrefaction. Examples of this kind of action are seen in salting meat, and in preserving small animals in weak solutions of carbolic acid.

3. That of preventing or arresting decomposition by killing the torulæ associated with fermentation in slightly acid media, or the bacteroid organisms associated with putrefaction in neutral or alkaline media. Properly speaking, this is the action of an antiseptic, but the relative power of disinfectants has been largely estimated by their efficacy in this respect—partly, no doubt, because antiseptic power is desirable in a disinfectant, but chiefly because it is so difficult to submit disinfectants to their proper test by experimenting upon contagium. Recent experiments upon inhibition of growth of pathogenic bacteria show that mercuric chloride,

allyl alcohol, oil of mustard, and certain other ethereal oils prevent the growth of anthrax bacilli in extreme dilution. Quinine, two parts per thousand, prevents the development of anthrax bacilli or that of the spirochætæ of relapsing fever.

4. That of the destruction of the noxious products of the metabolism of dead organic matter, however brought about. These products consist chiefly of gases or vapours, many of which, such as sulphuretted hydrogen, ammonia, and sulphide of ammonium, are easily destroyed by appropriate agents, even when used in a very dilute state; and success in this respect is no proof of the value of a disinfectant in its true sense, though the power of destroying such emanations is possessed by almost all disinfectants of practical utility.

General Remarks.—It has been proved that the contagia of several diseases must consist of minute solid particles, for they are neither soluble, nor diffusible, nor volatile; they can be seen with the microscope, and can be cultivated out of the body; and we may infer that all other contagia are particulate likewise. A characteristic of contagium, due to its particulate nature, is that dilution lessens the chance of infection, but has little effect upon the case if the disease be taken. There is either no effect at all, or a full specific effect. Contagium particles are apt to exist as clouds in air, water, or milk, instead of being equally distributed throughout; and this bears upon practical disinfection. The particulate and non-gaseous form of contagium floating in the atmosphere prevents it from being absorbed by any liquid or solid disinfectant which does not wash or come into intimate contact with every portion of the air, and as this is impracticable, infected air can only be purified by gaseous disinfectants, such as sulphurous acid or chlorine. Disinfectants of this kind, to be effective, must be present in such a quantity as is incompatible with the existence of human beings. From this it follows that saucers of disinfecting fluids, or irritating vapours and gases in the sick-room, are merely a useless annoyance to the patient, except in so far as they may be desired as deodorants. The best method for dealing with infected air is to replace it by ventilation, especially by means of *ventilating* open fire-places. The proper use of volatile disinfectants is the purification of walls, ceilings, and inaccessible places; and for this purpose, if possible, enough should be used to saturate the atmosphere, remembering that the virulent particles are most likely protected by being buried in a bit of epithelium or surrounded by an albuminous envelope.[1]

The nature of the medium in which contagious particles are suspended has the most important bearing upon the selection of a disinfectant. The presence of albumen is found to protect septic germs to a considerable extent against the action of permanganate of potassium and chlorine, but has little or no influence upon the action of sulphurous acid and carbolic acid. A striking instance of this was noticed by Schill and Fischer, who found that fresh tubercular sputum containing bacilli and spores was not disinfected in twenty-four hours by an equal volume of solution of mercuric chloride 1 in 500, though an equal volume of 5 per cent. carbolic acid solution accomplished the disinfection in that time. This possibly explains in part the contradictory results obtained from experiments with disinfectants, and also shows the necessity of thoroughly mixing disinfectants with liquids or substances to be disinfected.

Some pathogenic organisms, such as the bacilli of anthrax, are very easily killed, while others, such as the spores of the same bacilli, are extremely resistant. It is possible that in many cases the contagium may be of a species or at a stage when it can be readily destroyed by a feeble disinfectant, but in the absence of knowledge prudence requires the opposite assumption.

A cardinal principle in disinfection is that it should be carried out at the source, or as near the source, of the contagion as possible. Inunction with lard, with carbolised oil (1 to 40), or with glycerine, to clog epithelial scales, and regular washing and change of clothing, will do much to protect the purity of the air against contagium proceeding from the skin in such diseases as scarlet fever and small-pox. One part of ethereal solution of peroxide of hydrogen to eight parts of lard is an excellent application for the skin in typhus. Discharges from the mouth, nose, and bowels, as well as the urine, should be received in vessels containing disinfecting solutions to cover them and give protection to the air; and then larger quantities, or more concentrated solutions, as the case may be, should be thoroughly incorporated with the discharges before they are removed from the original vessels.

Of all agencies for preventing the spread of communicable disease, cleanliness is one of the most important. Facts have been adduced pointing to the conclusion that filth, when undergoing change of a fermentative or putrefactive nature, is in a condition the most conducive to the extension of infectious disease. This is probably explained by the rapid multiplication of any specific disease-organisms contained in the filth. Pending the removal of accumulations of dirt, and for the protection of workmen, fermentation may be delayed by the application of crude carbolic acid, or solution of mercuric chloride.

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[1] Though disinfectant or antiseptic gases of such strength as can be tolerated in the sick-room are utterly inept as regards useful effect upon contagium, it is just possible that they may be of service in destroying or rendering incapable of change the organic matters evolved from the skin and lungs, which are always very noxious, and may be especially so in disease. These organic matters are necessarily more or less re-breathed unless the patient be placed in a current of air. If ventilation sufficient to prevent all odour cannot be provided, then some gas, such as chlorine or ozone, that will destroy the cause of the odour, is certainly desirable.

The ultimate fate of contagium is to be destroyed by putrefaction, and this appears invariably to destroy its specific infective power. In certain cases where real disinfection is impracticable, as in dealing with the accumulation of manure and litter from a number of animals suffering from cattle-plague, the natural processes may be hastened by stacking the material so that it shall 'heat,' or may even be destroyed by spontaneous combustion. Certainly putrefaction should not be delayed by small additions of disinfectants, which cannot accomplish the destruction of all noxious matter present.

SPECIAL DISINFECTANTS.—1. **Heat.**—Heat, dry or moist, is perhaps the best disinfectant we possess. High temperature and length of exposure are, to a certain extent, mutually compensatory, but it appears that a temperature below 140° F. (60° C.) will not disinfect vaccine even with long exposure. Tyndall points out that some germs seem to be in a dormant condition, in which they resist the action of heat unless applied very long or intermittently, so as to start their vitality into growth, when they are easily killed. Disinfection by dry heat (which is, however, best for the destruction of insect vermin) is now being superseded by steam. Dry heat penetrates so slowly into fabrics that they are injured before a disinfecting temperature is attained throughout. The presence of moisture assists the action of hot air, as it likewise does that of gaseous SO_2 and Cl. Koch found that 1½ hour's exposure within test-tubes in an oven containing air saturated with moisture at a temperature from 230° F. to 245° F. destroyed sporeless micro-organisms and spores of fungi, but did not affect spores of the bacilli of potato, hay, and anthrax, nor the spores of garden earth. These were all destroyed by three hours' exposure to 284° F. A current of steam at 212° F. destroyed spores of earth, anthrax, and tubercle-bacilli in less than fifteen minutes, when they were freely exposed. Steam penetrates clothing quickly, but may take some time to raise the temperature of sheltered articles, especially if wet. Modern steam-disinfectors are made with a jacket space to which live steam may be admitted, so that the internal chamber may be used as a simple hot-air chamber where steam is not admitted directly to it. With a proper apparatus the articles come out dry. Steam instantly ruins leather, and fixes permanently any stains of blood or discharges. Stained clothing should be previously soaked in cold water and the water afterwards disinfected by mercuric chloride.

It has been abundantly proved that ordinary boiling and washing will completely disinfect the linen of a fever hospital. The water should attain the full temperature of 212° F.

Nearly all the chemical agents used in disinfection are mutually incompatible, and therefore only one should be used at a time.

2. **Carbolic Acid.**—A solution of this substance of the strength of 5 per cent., or 1 in 20, is the only one fit for use in disinfection. For steeping fine clothing a solution should be made from crystals. The solution generally useful is that obtained by making up one gallon of crude 80 per cent. acid to sixteen gallons with water. The results of the experiments of Baxter and others prove that 'no virulent liquid can be considered disinfected by carbolic acid unless it contain at least 2 per cent. by weight of the pure acid.' More recent experiments show that in some cases this proportion of carbolic acid is not nearly enough. Anthrax spores required to soak over twenty-four hours in 5 per cent. carbolic solution to be destroyed, though blood containing anthrax bacilli was almost instantly sterilised by a 1 per cent. solution. With our present knowledge it would be safer to employ stronger acid, or in any case to use a large quantity of 5 per cent. Combinations of carbolic acid are greatly inferior to the pure acid, and its solutions in oil and alcohol are found to be absolutely inert. Thymol and salicylic acid are affected in the same way by solution in oil. Judging from the light of experiments, carbolic acid vapour is quite useless. Very small quantities of the liquid acid mixed with organic fluids enable them to remain fresh and resist decay for a long time. So little as one-fifth per cent. preserves milk. It is obvious then that small quantities of this disinfectant, instead of destroying contagium, may actually preserve its activity, when otherwise it would have succumbed to the action of natural agencies. This danger may accompany the limited use of any disinfectant that has a 'pickling' or preservative action in small quantity. Owing partly to the volatility of carbolic acid, which removes it in time, and partly to the peculiarity of its action, another danger attends its use in anything short of full strength and large quantity when applied to kill contagium. The acid may, for a time, deprive the contagium of its infective power without permanently abolishing it, and the virulent properties may be regained whenever the acid has evaporated. This has been proved experimentally by Dr. Dougall, of Glasgow, who found that vaccine mixed with carbolic acid (1 in 50) *regained* its infective power after 10 days' exposure to the air.

For removing odour from the hands after working in the dissecting-room, a 1 per cent. solution of carbolic acid is superior in efficacy to permanganate of potassium, even when strong enough to stain the skin, and is also preferable to chlorinated lime.

3. **Sulphur Dioxide.** — The aqueous solution of this substance contains sulphurous acid. It destroys sulphuretted hydrogen thus, $SO_2 + 2H_2S = 2H_2O + S_3$, and combines with ammonia. For aërial disinfection the best plan is simply to burn sulphur in very large quantities. Even in presence of abundant moisture, Koch pronounces SO_2 useless for practical disinfection. By volume, 10·5 per cent. of the gas in a room failed to affect spores of anthrax, &c., in twenty-four hours, whether wet or dry. About 3 per cent. in forty-eight hours had not destroyed the vitality of micrococcus prodigiosus, pink yeast, or bacteria of blue pus. In an ordinary room a gaseous disinfectant rapidly disappears. On the other hand, Cyrus Edson tries, from the statistics of the Health Department, N.Y., to prove the efficacy of SO_2 fumigation (3 lbs. sulphur to 1,000 cubic feet) in small-pox, scarlet fever, and to a less extent in measles- and diphtheria-infected houses. The statistics are not convincing to the present writer. Sulphur dioxide destroys the activity of dry vaccine on points very rapidly, and even when much diluted stops the amœboid movements of living cells, kills vibrios, and acts deleteriously on vegetation. Sulphur dioxide preserves meat and other substances, when in closed vessels, for very long periods. It bleaches vegetable colours, attacks iron, and is absorbed by cloth and leather—facts to be remembered in practical disinfection. 1 lb. of sulphur, when burned, produces 11·7 cubic feet of sulphur dioxide gas.

4. **Chlorine.**—Chlorine is most easily obtained from 'chloride of lime' or bleaching powder, by adding hydrochloric or sulphuric acid. Exact proportions cannot be stated, as the value of the bleaching powders varies; but rather more acid than of the equal parts of bleaching powder and strong hydrochloric acid may be taken. The acid should be diluted before use. For deodorising water-closets, some crystals of potassium chlorate may be thrown into a wide-mouthed bottle containing dilute hydrochloric acid. Euchlorine comes off gradually, and is both more effective and more agreeable than chlorine. The most marked character of chlorine is its strong affinity for hydrogen, which enables it to break up compounds containing that body, and to set free in a nascent or active state the oxygen combined with hydrogen in water. It is, therefore, one of the most universally applicable and powerful deodorisers in existence. When merely used as a deodoriser, enough euchlorine may be expelled from moist 'chloride of lime' by the carbonic acid of the air for most purposes. In air *saturated* with moisture 0·3 per cent. chlorine kills all minor organisms that are freely exposed; but any cover, such as a piece of blotting-paper, prevents the result. Less moisture demands 1 per cent. chlorine.

5. **Permanganate of Potassium.**—This substance is non-poisonous, and is a good deodorant, especially for the emanations from organic bodies. It is, moreover, free from odour, and its aqueous solution shows, by loss of colour, when it is exhausted. It is a very suitable deodorant for the sick-room, as, when dissolved in water and a large surface of the solution exposed to the air, it will absorb gases to some extent. Contagium, being non-gaseous, is not affected, unless in contact with the solution. Permanganate of potassium is a true disinfectant, oxidising and destroying contagia as well as putrid matters; but the quantity required and the price render its use almost impossible, for enough permanganate has to be used to destroy the medium or vehicle bearing contagium as well as the contagium itself. The solution should contain 5 per cent. permanganate after all chemical action has subsided. Condy's fluid is a solution of this substance in water. When the virulent liquid or matters are small in quantity, permanganate solution forms a capital recipient, and may stand by the bedside as a deodorant till required as a disinfectant. Permanganate has no effect in restraining the appearance of bacteria, or preventing the onset of putrefaction.

6. **Acids.**—The mineral acids and glacial acetic acid have all disinfecting power when used in sufficient quantity for a long time, but there are serious difficulties in the way of their use. HCl, 2 per cent. in solution, required ten days to kill anthrax spores.

7. **Nitrous Acid.**—Nitrous acid can be easily disengaged as a gas by putting bits of copper into nitric acid, or pouring nitric acid upon sawdust or starch. It is the best deodorant for the deadhouse, and, without doubt, it is a disinfectant, but it is too dangerous for ordinary use, as it may easily be breathed in quantity sufficient to cause fatal bronchitis.

8. **Chlorinated Lime.** — Bleaching-powder, commonly known as 'chloride of lime,' gives off chlorine easily, and this probably explains its disinfecting power. It is very cheap and manageable, and hence of much importance.

9. **Quicklime.** — Liborius Kitasato and Pfuhl, confirmed by Drs. Richard and Chantemesse, state that fresh excreta of cholera, enteric fever, and dysentery are sterilised, and the bacilli destroyed, so that the stools are disinfected, by 2 per cent. of a 20 per cent. fresh milk of lime in a few hours. The experiments detailed are not conclusive to the writer as to real disinfection in all cases. Quicklime is so cheap and abundant, that it could be used in any quantity. It is soluble in water in the proportion of only 1 in about 700.

10. **Mercuric Chloride.**—*Perchloride of Mercury, Corrosive Sublimate, Malleus Metallorum*, the most powerful chemical disinfectant known, dissolves in 16 parts of cold water, is extremely poisonous, and corrodes metals. With albuminous matters it forms insoluble precipitates, which are prevented by addition of common salt, HCl, or tartaric acid. Precipitates must be prevented where disinfection has to be repeated, as they might be dangerous. The solution with tartaric acid is not stable, and should be freshly made. A spray of 1 in 1,000, or washing with 1 in 5,000, killed the most resistant organisms in ten minutes. Enough should be used to leave 1 in 5,000 after any $HgCl_2$ is precipitated by sulphur or albumen. After disinfection is finished, copious washing with water removes the remaining mercury salt. For utensils, clothing, &c., 1 in 2,000, and for excreta an equal bulk of 1 in 1,000 solution, are recommended.

In regard to the agents hitherto considered, we have more or less of the sure light of direct experiment upon contagium ; but the claims of the following and a legion of other substances asserted to be 'powerful disinfectants, of which it is impossible to speak too highly,' rest entirely upon chemical theories, or the opinions of physicians, or upon their power of coagulating albumen, or of delaying or preventing putrefaction and fermentation, or of deodorising. It will be scarcely necessary to do more than enumerate the best, as follows:—

11. **Metallic Salts.**—Metallic salts include—(*a*) *Bichromate of potassium.* (*b*) *Sulphate of copper.* (*c*) *Chloride of zinc.* A 5 per cent. solution had no effect on anthrax spores in a month, and 1 per cent. failed to kill micrococcus prodigiosus in forty-eight hours. (*d*) *Chloride of aluminium.* (*e*) *Ferric chloride*, which, if strong, liberates offensive fumes from animal matters, but is a fair antiseptic and preservative. (*f*) *Ferrous sulphate.* (*g*) *The waste chlorides*, from the manufacture of chlorine, contain $MnCl_2$, Fe_2Cl_6, and free HCl, which cost next to nothing, and might be used for larger masses of filth or drains.

12. **Ozone.**—This body, got by half-immersing a stick of phosphorus in tepid water, or by mixing gradually 3 parts of strong sulphuric acid and 2 parts permanganate of potassium, oxidises organic matter, and so destroys odours. Terebene and cupralum, a preparation containing terebene, are good deodorants, and give rise to ozone.

13. **Charcoal.**—Charcoal condenses gases within its pores, where combustible gases are destroyed by the condensed oxygen. Contagium, unless in water, does not enter the pores, for, being particulate, it is not absorbed from the air as gases are.

PRACTICAL DISINFECTION.—In conclusion, a few remarks may be offered as to the modes of carrying out disinfection under circumstances in which it is commonly required.

1. **Clothing and Bedding.**—In dealing with the ragged and worthless articles of the poor, local authorities will generally find it most satisfactory to both parties to burn them and replace them with new. By such discreet generosity danger is averted, and goodwill created, which helps in getting early information and carrying out measures, and so, by shortening epidemics, saves expense. If not burned, clothing may be steamed as described under *Heat*, or well boiled with soda. Before coming to the washhouse they may be steeped in 5 per cent. carbolic solution, or perchloride of mercury (1 in 2,000), or chlorinated lime (2 oz. to the gallon).

2. **Rooms.**—The essential process for disinfecting rooms is thorough cleansing with soft soap and hot water, which may contain 5 per cent. carbolic acid, but the carbolic solution is not so easily handled. The walls and ceiling should be brushed, and wall-paper removed. Furniture, if iron—a bedstead for example—is to be taken down and washed with carbolic solution, and removed from the room, or smeared with vaseline if to be fumigated. Textile fabrics should be steamed or boiled, or spread out in the room for fumigation; but this is not so effective, and colours are bleached. Should it be considered desirable to fumigate, the room should be steamed for some hours. The chimney, doors, and windows are to be closed, and crevices covered with paper pasted on. Then 15 lbs. chlorinated lime per 1,000 cubic feet, made into cream with water in shallow dishes, has 22 lbs. HCl added from vessels which tilt over as the operator escapes. The door is to be shut until next day, when the windows and doors are all to be opened, and kept open for twenty-four hours. In white-washed rooms the walls should be scraped, and then washed with hot lime in addition to the fumigation.

3. **Drains, Water-closets, &c.**—Proper drains remove sewage so swiftly and completely, that little or no sewage-gas is formed if ventilation is given. For bad drains carbolic acid, chloride of zinc, or waste chlorides from the manufacture of chlorine, are fair palliatives. The excreta from cases of infectious diseases require a very large quantity of disinfectant, which should be applied in a concentrated form before they are thrown into the water-closet or house-pipes. When a reliable amount of disinfectant is in these cases sent down the pipes, it is apt to corrode them unless it has been allowed to expend its energy on the excreta alone in the first place. If small quantities of disinfectants are poured down water-closets, it is better to mix them with the after-flush water which fills traps and basins, so that the little energy available may be devoted to the destruction of any slime adhering, or portions of organic matter retained. Permanganate

of potassium is the most pleasant agent for this purpose, though expensive. When there are no water-closets, the excreta, in cases of cholera and typhoid fever, should be received in a vessel containing half a pint or more of a 1-in-20 solution of commercial hydrochloric or sulphuric acid, and then put, along with some chlorinated lime, into a covered stoneware vessel in the back yard. After a few hours the contents of this vessel may be thrown into the cesspool or upon the midden.

4. **Dead Bodies.**—Dead bodies, if putrid or bearing contagium, should be wrapped in sheets wet with 1-in-20 carbolic solution, or 1-in-1,000 perchloride of mercury; or, if coffined, sawdust saturated with one of these solutions should be packed around them.

It is necessary clearly to keep in view the object desired when selecting disinfectants, deodorants, or antiseptics; whether it be destruction of contagium, merely 'pickling' and preserving, arresting putrefaction and fermentation, or deodorisation. From all that has been said it is evident that the different 'disinfecting' nostrums, applied as their inventors direct, can have little effect upon contagium, but may have more or less power in the other directions indicated.

James A. Russell.

DISLOCATION OF ORGANS (*dis*, apart; and *locus*, a place).—*See* Organs, Displacement of.

DISPLACEMENT OF ORGANS. *See* Organs, Displacement of.

DISSECTION WOUNDS. — *See* Post-Mortem Wounds.

DISTOMA.—*See* Entozoa.

DISTOMA RINGERI vel PULMONALE.—Under this name the writer originally described in the *Medical Times and Gazette* (July 8, 1882) a species of fluke, the mature form of which inhabits the human lung, where it was first found in Formosa, by Dr. B. S. Ringer, in 1879. The ova of the parasite have frequently been found by Professor Baelz, of Tokio, by the writer, and by others, and by them are associated with a peculiar form of recurrent hæmoptysis, to which the term *endemic hæmoptysis* has been applied.

Symptoms and Pathology.—The symptoms of disease associated with the presence of the distoma Ringeri are a slight cough; the expectoration of a characteristic rusty-brown, viscid mucus; and at times hæmoptysis, slight or copious. The hæmorrhage occurs at irregular intervals during many years. The expectoration of rusty bronchial mucus is persistent, and in this the ova are readily discovered with the microscope. These are pale brown bodies ($\frac{1}{300}$ in. × $\frac{1}{500}$ in.), ovoid, double-outlined, operculated at the broad end, and containing protoplasmic globules having very active molecular movements. If the sputum is occasionally shaken up in fresh water, there is developed in most of the ova, in the course of six weeks to two months, an active ciliated embryo which in time escapes by forcing back the operculum. It may be concluded from this that drinking-water, or a fresh-water animal acting as intermediary host, is the medium by which the disease passes from one human subject to another. *See* Entozoa.

This disease has hitherto been found only in Japan, Corea, and Formosa, but its distribution is probably much more extended.

The mature parasite measures from 8 to 10 mm. by 5 to 6 mm. It resides in cavities and burrows connected with the smaller bronchi, into which it discharges its ova. As many as twenty of these parasites have been found in one case.

Treatment.— Inhalations of sulphurous acid, sprays of turpentine, as well as kousso, quassia, and santonin, have been administered without much apparent benefit.

Patrick Manson.

DIURESIS (διὰ, through; and οὐρέω, I pass water).—A free excretion of urine, whether naturally or artificially induced. *See* Diuretics.

DIURETICS (διὰ, through; and οὐρέω, I pass water).

Definition.—Remedies which increase the secretion of urine.

Enumeration.—The following comprise the most important diuretics: Water; Milk; salts of Potassium, Sodium, and Lithium; Calomel; Alcohol, Nitrous Ether, solution of Ethyl Nitrite; Turpentine, Juniper, Copaiba; Cantharides; Digitalis, Strophanthus, Squill; Caffeine, Theobromine, and its compound with Salicylic Acid and Sodium termed 'Diuretin'; Tobacco; Scoparium, and Sparteine. The action of diuretics is often aided by brisk purgation, depletion, counter-irritation over the loins, and sometimes by the use of mercury.

Action.—The secretion of urine appears to consist partly of filtration of fluid through the glomeruli of the kidney, and partly of secretion by the cells of the urinary tubules. The amount of urine excreted depends on the rapidity with which the blood flows through the glomeruli, and this again depends on the height of the systemic blood-pressure and the dilatation or contraction of the renal arteries. The secretion is increased by anything which raises the blood-pressure throughout the system generally, or in the renal arteries locally. The systemic blood-pressure may be raised by cold to the surface, digitalis, squill, and tobacco. Digitalis, and possibly other drugs, have also a local action on the renal arteries, which are more readily affected by some drugs than other arteries in the body. Nitrous ether and solution of ethyl nitrite probably act as diuretics by dilating the renal arteries. The exact mode of action of the other diuretics is not determined; but common salt, nitrate of potassium, urates, and urea increase the flow of urine even although the pressure in the vessels of the kidney is very low. It is therefore probable that they stimulate secretion by acting on the nerves or cells in the kidney itself; and probably caffeine acts in a similar manner.

Uses.—Diuretics are employed to increase the flow of urine, and thus remove water or excrementitious products like urea from the body. They are used in cases of general dropsy, or of accumulation of fluid in the peritoneum or pleura. In febrile conditions they are given to aid in the elimination of waste matter. They are also employed in order to render the urine more watery, and thus prevent the deposition of solids from it, and the formation of calculi in the kidney or bladder, or to redissolve such concretions when they are already formed. Digitalis and squill are most useful in dropsy dependent on heart-disease; the other remedies are more effective in dropsy dependent on disease of the kidneys or liver. The action of digitalis and squill is greatly assisted by the addition of a little blue pill; and when the kidneys are much congested or pressed upon from without by accumulation of fluid in the abdominal cavity, diuretics sometimes fail to act until the congestion has been relieved by depletion from the loins or the use of a brisk purgative, and the pressure removed by paracentesis. *See* Dropsy.

T. Lauder Brunton.

DIZZINESS.—*See* Vertigo.

DOCHMIUS (δόχμιος, twisted).—A genus of nematode worms established by Dujardin. *See* Entozoa.

DORDRECHT, in Cape Colony.—*See* Africa, South.

DOTHIENENTERITIS (δοθιήν, a pustule; and ἔντερον, the intestine).—A synonym for a form of enteritis, accompanied by an enlargement of the follicles, which causes them to resemble pustules. *See* Intestine, Diseases of.

DOUCHE (Fr.).—Definition.—A jet of water propelled against some part of the body through a *doccia* or pipe. The size of the jet of water, the degree of its impetus, and its temperature can all be regulated. A douche differs from simple affusion in its application being more local, and the force with which it is applied being greater.

Application and Action.—Douches of cold and of hot water, of vapour, and occasionally of gas, are employed; but those by far the most commonly used, except where there are hot natural waters, are of cold water.

The immediate effect produced by a cold douche on those who are unaccustomed to it is a feeling of shock, spasmodic shortness of breathing, palpitation of the heart, and sometimes pain in the back of the head. Locally the first effect of a douche is to deaden the sensibility of the part to which it is applied; but if the douche be powerful enough, reaction of the part comes on in about forty seconds. This continues for a time; but if the douche be kept up for three or four minutes, the pulse falls seven or eight beats, the deadening of sensibility returns, and the temperature of the part is greatly lowered; when the douche is withdrawn, reaction again takes place. This alternate sedative and stimulating effect, producing emptiness and turgescence of the vessels, quickens the action of the capillaries of the part, and thus favours the transmutation of tissue. The mechanical effect of the force with which the douche is applied must not be overlooked. If great, it produces the highest amount of stimulation, which may almost amount to inflammation.

Different portions of the body have different degrees of tolerance of the douche. Thus the extremities and the head bear it better than the chest, and the chest somewhat better than the abdomen; and the posterior aspect of the body bears it much better than the anterior. Patients soon get accustomed to the cold. Warm douches produce less shock, and are more easily borne, but they are, comparatively speaking, little employed in private houses. An alternation of hot and cold douches, known somehow by the name of *Scotch*, is a valuable remedy; in it the hot water rapidly restores the irritability of the part deadened by the cold water, and there is a maximum of action and reaction of the part obtained. Under particular circumstances it may be expedient to use a jet of steam, but this, of course, must be done with caution; and a jet of carbonic acid is sometimes propelled against the eye or ear, or the neck of the uterus. So-called *ascending douches* are used for the rectum or the vagina. Douches for the eye and the ear have been used of late years. In a certain sense what the English call *pumping* is a variety of the douche, and the *shower-bath* is in reality merely a multiplication of fine douches. The action of douches is more or less general according to the portion of the body to which they are applied. Thus the application of a douche to the head has the most general action, and that to the spine the next. In either case it is impossible to limit it very strictly, and there is a certain amount of affusion besides the direct douche. A douche, again, applied to one of the extremities may easily be localised; and a douche may be applied only to one part or to several parts of the body in succession.

Douches merely require a pipe with nozzles of various sizes in connexion with a cistern at a certain elevation, or with a pumping machine; they can easily be improvised. Shower-baths can be procured with equal facility. A vapour-douche can be got by attaching a pipe to a vessel of boiling water. In the case of fine douches used for the eye, the water is propelled with sufficient force by the action of a caoutchouc bag worked by the hand. Carbonic acid is practically little used, and only where there is an abundant natural supply of the gas.

Perhaps 50° F. may be considered the average temperature of a cold douche, and from four minutes to a quarter of an hour its average duration. The course of douching will probably extend at least over a fortnight. As to the actual temperature of the water, the sensation it produces in the patient depends most on his condition. Thus water of 45° F. may feel ice-cold to one who has just quitted a hot bath. In like manner a douche of slightly-heated water may appear quite warm when applied to a part cooled by a cold douche. The temperature of a douche should vary according to the condition of the patient.

Uses.—As a general rule we may say that douches are only applicable in cases of chronic disease; that cold douches are most useful in constitutional diseases; and that warm douches, and the alternation of hot and cold, are most suitable in local affections. The use of hot and cold douches alternately has been much and successfully employed of late in France, for the treatment of certain nervous diseases.

The cold douche, when it is employed gradually and with judgment, is found serviceable in chlorotic and hysterical conditions, in hysterical paralysis, and in over-sensibility of the skin, with tendency to catch cold; and of late years it has formed a part of the special treatment of phthisis in elevated places. As cold affusion on the head is very serviceable in infantile convulsions, so the application of a douche of cold water to the head is a calmative and hypnotic in maniacal cases. It is, perhaps, not so much used in this way as formerly, because it has, like the shower-bath, come to be considered a sort of punishment to troublesome lunatics. Still it is a valuable agent. Hydropathic practitioners have found douches useful revulsives in congestion of the liver and of the uterus.

Locally douches have been used, but with moderate benefit only, in some cases of skin-affections and of chronic ulcers. Their principal local application, however, is in cases of old sprains, in chronic rheumatism or gouty thickenings of joints, in lumbago, in some neuralgias, and in paralysis when it is not too recent. The *Scotch* is far the most effective for these purposes, and there seems to be some evidence of its having been efficacious in threatened tabes dorsalis—certainly more efficacious than any other remedy. Douches might be used more extensively in private houses; still, as assistance is always required by the patient, public baths have advantages for their application.

John Macpherson.

DRACUNCULUS (*dracunculus*, a little dragon).—*See* Entozoa.

DRAINAGE.—*See* Public Health.

DRAKENSBERG MOUNTAINS, in Natal.—*See* Africa, South.

DRASTICS (δράω, I act).—Definition. Violent purgatives.

Enumeration.—The drastics most frequently employed are:—Hellebore, Podophyllin, Gamboge, Elaterin, Scammony, Jalap, and Croton Oil.

For action and uses of drastics, *see* Purgatives. T. Lauder Brunton.

DRIBURG, in Westphalia.—Strong Chalybeate Waters. *See* Mineral Waters.

DROITWICH, in Worcestershire. Common Salt Waters. *See* Mineral Waters.

DROPSY (ὕδρωψ: from ὕδωρ, water; and ὦψ, aspect, appearance).—Synon.: Fr. *Hydropisie*; Ger. *Wassersucht*.

Definition.—Accumulation of serous fluid in the subcutaneous cellular tissue, or in a serous cavity.

Dropsy is known by various other names, according to the portion of the body affected. When confined to the subcutaneous cellular tissue it is termed *œdema* or *anasarca*; to the peritoneal cavity, *ascites*. The term is often limited to these two forms of the disease; and exudations similar to that of ascites in other cavities are termed *hydropericardium*, *hydrocephalus*, *hydrocele*, *hydrops oculi*, *hydrops articuli*, and *hydrothorax* or *pleural effusion*, according as they are contained in the pericardium, arachnoid, tunica vaginalis, eye, joint, and pleural cavity respectively.

Pathology.—The accumulation of fluid in the tissues, or in a serous cavity, depends upon more fluid exuding from the blood-vessels than can be taken up by the absorbents. This condition may depend on an increase in the rapidity of exudation above the normal, or on a diminution in the absorption, or on both together. Increased exudation may be due to alteration (1) in the calibre of the arteries or capillaries; (2) in the condition of their walls; (3) in the condition of the blood; and (4) possibly also in the condition of the tissues. Diminished absorption is chiefly due to obstruction of the absorbents, although alteration in the tissues may also play a part. Obstruction may be (1) local or (2) general. So long as no obstruction to absorption occurs, it rarely happens that more fluid can exude from the blood-vessels than the absorbents can again take up. Absorption is partly carried on by the veins, and partly by the lymphatics; principally, however, by the veins. When venous obstruction takes place, fluid is apt to accumulate in that part of the body from which the blood ought to return by the obstructed vessel. But it does not always so accumulate; for it may happen that the lymphatics are able to absorb all the fluid which exudes from the capillaries, and to return it into the general circulation. Thus it has been found by Ranvier that ligature of the vena cava in a dog does not usually produce œdema of the lower extremities, but if one sciatic nerve be divided in such an animal, the corresponding leg at once becomes œdematous. The reason of this is that, so long as the nerve is intact, the lymphatics can absorb all the fluid which exudes from the capillaries; but when the nerve is divided the arteries dilate, more fluid is poured out than the lymphatics can absorb, it accumulates in the tissues, and œdema ensues. This œdema is not due to paralysis of the limb, but to paralysis of the vessels. For if the sympathetic fibres through which the vaso-motor nerves pass to the sciatic nerve are divided before they join the motor fibres of that nerve in the sacral plexus, the power of movement remains unimpaired, but œdema occurs just as if the whole nerve had been divided. If, on the other hand, the motor strands of the sacral plexus are cut before they are joined by the sympathetic fibres, the limb is as completely paralysed as if the sciatic nerve had been cut, but no œdema takes place. Any obstruction to the venous flow will operate in the same way as ligature of a vein, though to a less extent, the effect varying according to the amount of obstruction. Thus regurgitation of blood through the tricuspid valve tends to produce general anasarca, and obstruction to the portal vein by cirrhosis of the liver tends to cause accumulation of fluid in the abdominal cavity.

It has been mentioned how great an influence dilatation of the arteries from vaso-motor paralysis has upon the *production* of œdema in cases where the veins are obstructed. Arterial dilatation may also produce a local œdema, even when no such obstruction is present, as, for instance, in the tissues around an inflamed part. It has been shown, however, by Winniwarter, that the walls of vessels in an inflamed part are more permeable, and allow fluids to pass through them more easily than healthy vessels will do. It is probably in consequence of this that we find that a slight stimulus, such as scratching the skin, which ordinarily produces in a healthy person only slight dilatation of the capillaries, and consequently redness of the part scratched, will produce an effusion from the vessels, and local swelling of the part at the point scratched, in persons suffering from urticaria. The same thing takes place when the skin is scratched in the neighbourhood of a part stung by a wasp.

But this alteration in the vessels is not the only cause of the œdema, which may occur without any obstruction to the circulation. An alteration in the composition of the blood appears to allow it to permeate more easily into the tissues, and to produce œdema, even when there is no obstruction of the veins. In cases of anæmia we find œdema, occurring at the ankles, although there is no obstruction to the venous circulation other than that caused by the weight of the column of blood itself. In these cases, however, we have dilatation of the vessels, as is shown by the form of the sphygmographic tracing, and an altered composition of the blood is evidenced by the anæmic look of the patient. In albuminuria the altered composition of the blood appears to be the chief factor in the production of œdema, as the pulse in such cases may be hard, evidencing arterial contraction, and not relaxation.

Ætiology.—General dropsy affecting the subcutaneous tissue, the peritoneal cavity, and the internal serous cavities and organs generally, is usually the result of albuminuria, and most frequently of that form which depends on acute nephritis, or on fatty degeneration of the kidney. In cirrhotic disease of the kidney the loss of albumen in the urine is much less, and the alteration in the composition of the blood consequently is not so great as in the first-mentioned form. The arterial tension also is greater than usual, instead of being less. In the amyloid form the œdema is generally moderate.

The next most common cause of dropsy is tricuspid regurgitation, obstructing the venous circulation throughout the body. This regurgitation generally depends on dilatation of the right ventricle consequent upon obstruction to the flow of blood through the lungs, either from chronic bronchitis and emphysema, or mitral obstruction and regurgitation. Dropsy from cardiac disease generally appears first in the feet if the patient has been for some time in an upright position, while dropsy with albuminuria is often first remarked by a puffiness of the eyelids. In the former it appears where the greatest obstruction to re-absorption takes place, and in the latter case in those parts where looseness of the cellular tissue most readily allows of exudation.

Local dropsies have, as a rule, local causes. Even the swelling of the feet in anæmic young women, although dependent on a general cause, namely, dilatation of the vessels, and altered composition of the blood, is determined locally by the greater obstruction to the venous circulation which the pressure of the long column of blood in the veins between the feet and the heart presents. In general dropsy also, those parts which are most dependent are apt to become most swollen. It is not, however, always so, as in certain cases the dependent parts have been noticed to be less dropsical than the others. This curious phenomenon seems to be due to some vaso-motor nervous influence on the vessels of the dependent part. The local œdema of a brawny character, often noticed around inflamed parts, is partially due to swelling of the tissues themselves, and partially to effusion of fluid between them. This effusion, as has already been mentioned, appears to be caused both by the dilatation of the vessels observed in inflamed parts, and by the greater readiness with which fluids pass through them.

Dropsy in Serous Cavities. — The serous cavities of the body—the arachnoid, pleura, pericardium, peritoneum, &c.—are now known to be large lymph-sacs, in communication with the general lymphatic system of the body. The fluid which exudes into them from the blood-vessels is, in the peritoneum and pleura, removed, at least in part, by a pumping action in the movements of respiration. The central tendon of the diaphragm contains spaces, the walls of which are alternately drawn apart and pushed together during its ascent and descent. Their separation draws up lymph from the abdominal cavity, and their compression forces it onwards through the lymphatic vessels. The same thing occurs in the costal pleura, during the respiratory expansion and contraction of the chest. The accumulation of fluid in serous cavities may be due, like its accumulation in the cellular tissues, either to diminished absorption or increased exudation. The diminished absorption occurs here in consequence of pressure upon veins, and possibly also from interference with the pumping action just described. Accumulation of fluid in the ventricles of the brain, or in the sub-arachnoid cavity, is chiefly due to compression of the veins of Galen. In the peritoneum it may be due to obstruction of the portal vein by cirrhosis of the liver or by the pressure of tumours; and it may occur to a greater or less extent in all cavities of the body from general obstruction of the venous circulation, by disease of the heart or lungs, in the same way as anasarca. It may also occur in these cavities from alteration in the blood, as in Bright's disease. Active dropsy may occur in a serous cavity from inflammation, and here the exudation of fluid is much more rapid than in passive dropsy, the vessels of the inflamed part being dilated and more pervious than usual.

Treatment.—The first thing to be considered in the treatment of dropsy is the removal of its cause, if this be at all possible. Where it is due to obstruction of a vein we must hinder, as much as possible, the accumulation of fluid in the vein, by preventing the part from remaining in a dependent position, while at the same time we try to aid the absorption of fluid by the lymphatics by gentle upward friction. Where it is due to obstruction of the circulation in the lungs, we must diminish, as far as possible, all obstruction to the pulmonary circulation by inhalations, emetics, and expectorants, pushed if necessary so far as to cause nausea or even vomiting. Where the obstruction is due to dilatation or valvular disease of the heart, we must lessen the work the heart has to do, and insist in bad cases on absolute rest in bed or on a couch, in which the patient's position can be altered, but which he should not leave. An absolute milk diet, like that used in typhoid fever, is often of the greatest possible service, if it can be borne. At the same time we should aid the heart to contract more powerfully by the use of cardiac stimulants, such as alcohol and digitalis. Digitalis probably has a threefold action in cardiac dropsy, by strengthening the heart, by contracting the vessels, and by stimulating the kidneys. It strengthens at the same time that it slows the cardiac pulsations, and by making the heart contract more powerfully it keeps up the onward current of the blood more efficiently, and at the same time lessens the dilatation which tends to render the valves incompetent. Besides its effect on the heart, digitalis has also an action on the vessels, causing the arterioles to contract, and probably reducing the dropsy in this way. For the contraction of the arterioles produced by digitalis is exactly the converse of the condition which occurs after division of the vaso-motor nerves, and which, as we have seen, produces dropsy whenever any obstruction of the circulation exists. It is not known at present whether digitalis also causes increased absorption, but it seems highly probable that it does so, because we know that it stimulates the vaso-motor centre, and stimulation of this part of the nervous system has been shown by Goltz to increase greatly the rapidity of absorption from the lymph-sac of the frog. In addition to this action on the heart and vessels generally, digitalis possesses a specific action upon the vessels of the kidney. It is a powerful diuretic, and by thus lessening the amount of water in the blood it will tend to increase the absorption of serous fluid either from the cellular tissue or serous cavities. When digitalis alone does not succeed, the addition of squill and of a small quantity of blue pill frequently increases its efficacy. Digitalis succeeds best in dropsy caused by valvular disease or dilatation of the heart. Sometimes strophanthus, convallaria, or adonis vernalis may succeed when digitalis fails; but in general digitalis is best. It is not so useful in dropsy arising from renal disease, and here other diuretics are preferable. One of the best is spirit of juniper, given either as a mixture or in the form of Hollands gin. Spirit of nitrous ether, nitre, bitartrate of potassium, and broom are useful in all forms of dropsy. Caffeine is sometimes very useful. Theobromine, the active principle of cocoa, seems also to be useful, and a compound of it with salicylic acid and soda has been recommended under the name of 'diuretin.' Copaiba occasionally succeeds where other diuretics fail. It seems to be most successful in dropsy due to cirrhosis of the liver. Hydragogue cathartics, such as compound jalap powder, elaterin, &c., which cause copious watery secretion from the intestines, supplement the action of diuretics, and relieve or remove dropsy by removing water from the body, as well as altering its nutrition. Calomel seems to have an almost specific diuretic action, and is useful either alone or in combination with other diuretics or purgatives. In some cases of Bright's disease considerable relief has been obtained by the profuse sweating induced by vapour baths, hot-air baths, jaborandi, or pilocarpine. When the dropsy does not yield to other remedies, the fluid must be removed by paracentesis in the case of serous cavities, and by small superficial incisions or punctures, or by the insertion of very fine trocars with drainage-tubes attached, in the case of the limbs.

T. Lauder Brunton.

DROWNING, Death by.—The term 'drowning' is employed, in an extended sense, to signify death from submersion in a liquid medium, and in a more restricted sense to signify death in consequence of obstruction of respiration so caused. Now, though death must necessarily ensue from asphyxia, when the air-passages are submerged, apart from any other complication, asphyxia is not always the mode of death in those who were alive at the moment of submersion. For death may result from mechanical injuries, concussion, shock, syncope, or apoplexy in the very act, or at the moment, of falling into the water. Devergie estimates that 12·5 per cent. of deaths occur from one or other of these causes. In the remaining 87·5 per cent. the phenomena of asphyxia pure and simple are present only in 25 per cent., while in 62·5 per cent. these are more or less modified by the causes above-mentioned, to which must be added the benumbing influence of cold.

When death is not sudden from shock, &c., the ultimate result is the same in the swimmer or non-swimmer, if there be no escape or rescue. All efforts to keep above water fail, vain clutchings are made at whatever comes within reach, water is drawn into the lungs and more or less swallowed, all struggles finally cease, and the body sinks.

The indications of such instinctive efforts form the most important evidence of submersion during life. Drowning is not necessarily to be inferred in the case of a dead body removed from the water; for the body may have been thrown in after death from other causes—asphyxia among the rest.

The Evidence of Death from Drowning. This is cumulative, for we can scarcely say that there is any one indication invariably present which can be looked upon as due to drowning and to nothing else. But one or other, or more, of the following appearances are generally found.

External.—The face is either pale, or slightly livid, and frequently bloated if the body has lain some hours in the water. Water flows from the mouth when the body is turned face downwards. Foam at the mouth and nostrils is common; and the tongue is swollen and congested, closely applied to the teeth, or even clenched between them. The skin is pale, or marked here and there by livid discolorations, and the muscles of the hair-bulbs are rigidly contracted, causing the appearance of goose-skin, or *cutis anserina.*

The penis, according to Casper, is retracted, but the more common condition is one of semi-erection.

Indications of struggling are sometimes seen in excoriations of the hands, mud and sand under the nails, or even weeds, straws, or other small objects tightly clenched in the hands.

Internal.—The trachea, bronchi, and smaller air-tubes are congested and filled with a mucous froth, more or less tinged with blood. The lungs themselves are congested, œdematous, and pit on pressure. Pressure on them causes froth to exude into the smaller bronchial tubes, and on section a sanguinolent froth and water escape. Indications may be seen of sand, mud, or small weeds drawn deep into the air-passages along with the water in which submersion took place. Water is often found in the pleural cavity.

The stomach occasionally contains water. If this has any special character by which it can be identified with that in which submersion occurred, and not likely to have been drunk to quench thirst, it excludes the theory of its having been swallowed before submersion, and is a strong presumption, if it cannot be said to be a certainty, that it was swallowed during the death-agony, and did not find its way into the stomach after death. The same may be said of water in the lungs.

The right side of the heart and venous system in general frequently present the appearances characteristic of asphyxia; and the brain is often congested. *See* Asphyxia.

Without relying on any one sign as conclusive, we may say that a body which exhibits goose-skin, semi-erection of the penis, excoriations, &c., of the hands, froth at the mouth, water in the lungs and stomach, and congestion of the right heart and venous system, certainly died from drowning. In the presence of some and in the absence of other indications, a careful weighing of all the facts is necessary; but in most cases a satisfactory conclusion can be arrived at.

Complete submersion is usually sufficient to cause death within two minutes; but cases have been recorded of resuscitation after a much longer period. Many of these can be attributed to the exaggerated estimation of time by anxious on-lookers; but there are other well-authenticated instances, which may be explained by the supervention of syncope and temporary cessation of the respiratory process. That which renders resuscitation after submersion less likely than after a corresponding period of mere suffocation is the entry of water into the lungs by aspiration.

Treatment.—The treatment of the drowned consists in the persistent use of artificial respiration (*see* Artificial Respiration; and Resuscitation) so long as any signs of life remain, together with the application of means to counteract the great abstraction of body-heat which occurs even when the aërial temperature is comparatively high. Before commencing the movements of artificial respiration, the mouth and nostrils should be freed from water and froth, by holding the head somewhat low, face downwards, for a few seconds. Artificial respiration should then be immediately proceeded with. At the same time the wet clothes should be removed, and the body wrapped up in warm clothes obtained from bystanders, pending the arrival of warm blankets, hot bottles or bricks, &c., from the nearest house. Assiduous friction of the extremities should also be kept up. These directions—artificial respiration excepted—naturally presuppose assistance. If this be not at hand, the operator must rely mainly on artificial respiration. In the performance of artificial respiration by Sylvester's method, especial care must be taken against pressing on the stomach, for as it so frequently contains water, this may be forced up the œsophagus, and drawn into the lungs by the next inspiratory movement.

When spontaneous respiratory movements commence, attention should be directed to maintain life by the application of warmth externally, assiduous friction of the limbs upwards, and the administration of brandy and water, wine, or coffee. Lung-complications should be watched for and counteracted.

D. Ferrier.

DROWSINESS.—Inclination to sleep. *See* Sleep, Disorders of.

DRUG-ERUPTIONS.—Synon.: *Dermatitis medicamentosa.*

Many medicines produce at times various eruptions or discolorations of the skin, owing to idiosyncrasy, irritability of the gastro-intestinal mucous membrane, or defective power of elimination on the part of the patient; or, on the side of the drug, from the largeness of the dose or its long-continued administration.

These toxic lesions may be divided into three classes:—(1) Those inflammatory eruptions which are *special to the drug*, such as the agminated pustular eruptions produced by bromine or iodine compounds (*see* Bromism; and Iodism). (2) Various inflammatory eruptions *not distinctive* in themselves, their nature being only recognisable from the surrounding circumstances. (3) *Discolorations* of the skin, such as are produced by arsenic and nitrate of silver. *See* Pigmentary Diseases.

The great bulk of medicinal eruptions are either erythematous or urticarial, but the kind of eruption produced by the same drug often varies according to the individual who takes it. With the exception of the special eruption of iodides and bromides, the lesions are probably due to irritation of the gastro-intestinal mucous membrane acting reflexly on the vascular nerves of the skin; for in many instances the dose has been too small, and the eruption has followed too quickly on the ingestion of the drug, for the rash to be due to the absorption and circulation of the substance itself. With the exception of the special bromide and iodide eruptions, the diagnosis cannot be made from the aspect of the rash. The following lists do not pretend to be quite complete, but represent all the chief eruptions and the drugs which produce them:—

List of Drugs and of the Rashes which they Produce.

Antipyrine (*Phenazone*).—Erythema—diffuse, patchy, papular, or morbilliform; urticaria; miliaria.

Arsenic.—Erythema—diffuse and erysipelas-like, papular; acuminate or morbilliform; urticaria, vesicles, pustules, furuncles, herpes zoster, gangrene, pigmentation.

Belladonna.—Erythema—diffuse, scarlatiniform, or patchy.

Benzoate of sodium.—Erythema—patchy.

Borax.—Psoriasis, or a scaly eruption like it.

Boric acid.—Erythema, followed by vesicles.

Bromine compounds.—Erythema—diffuse, patchy, papular or morbilliform, 'nodosum'-like; urticaria, bullæ, pustules—discrete or agminated, furuncles, ecthyma (indirectly), eczema.

Calomel injection.—Erythema, scarlatiniform in one case.

Cannabis indica.—Vesicles.

Chloralamide.—Erythema.

Chloral hydrate.—Erythema—diffuse, papular, and scarlatiniform; urticaria, vesicles, bullæ, pustules, purpura, shedding of nails.

Chlorate of potassium.—Erythema, papular; discoloration, bluish or icteric.

Chloroform.—Purpura.

Chrysarobin.—Erythema—diffuse, with œdema, eczema, once pityriasis rubra.

Cod-liver oil.—Vesicular, pustular.

Copaiba.—Erythema—diffuse, patchy, or scarlatiniform; miliary papules, petechiæ, vesicles, bullæ, urticaria.

Cubebs.—Erythema—papular, miliary, or morbilliform.

Digitalis.—Erythema—scarlatiniform or papular.

Iodine and its compounds.—Erythema—diffuse, papular, morbilliform, or nodosum-like; urticaria, discrete pustules, vesicles, purpura, gangrene.

Iodoform.—Erythema—diffuse or scarlatiniform; papules, vesicles, bullæ, eczema, purpura.

Mercury.—Erythema—diffuse, like erysipelas.

Morphine and opium.—Erythema—scarlatiniform, papular, morbilliform; vesicles and bullæ; never any rash from hypodermic injection.

Phosphorus.—Bullæ, purpura, icterus.

Quinine.—Erythema—diffuse or patchy, scarlatiniform; papules, acuminate or morbilliform, urticaria, vesicles, bullæ, furuncles.

Salicylic acid and its compounds.—Erythema—diffuse; urticaria, vesicles, pustules, purpura.

Salol.—Urticaria.

Santonin.—Urticaria.

Strychnine.—Erythema—scarlatiniform.

Tar.—Erythema; locally a form of acne.

Terebene.—Erythema—papular.

Turpentine.—Erythema—diffuse, papular, acuminate, or morbilliform; vesicles.

List of Eruptions and of the Drugs which produce them.

Diffuse or patchy erythema.—Antipyrine, arsenic, belladonna, benzoate of sodium, boric acid, bromides, chloralamide, chloral hydrate, chrysarobin, copaiba, iodides, salicylic acid, stramonium, tar.

Scarlatiniform erythema.—Belladonna, chloral hydrate, copaiba, iodoform, quinine, strychnine, bromide of nickel.

Papular or morbilliform erythema.—Antipyrine, arsenic, bromides, chloral hydrate, cubebs, morphine, quinine, terebene, turpentine.

Nodosum-like erythema.—Bromides and iodides.

Urticaria.—Antipyrine, arsenic, bromides, copaiba, iodides, morphine, quinine, resin, salicylic acid, salol, santonin.

Vesicles.—Cannabis indica, chloral hydrate, cod-liver oil, copaiba, iodides, morphine, quinine, salicylic acid, and turpentine.

Bullæ.—Bromides, cannabis indica, chloral hydrate, copaiba, iodides, morphine, phosphoric acid, quinine.

Pustules.—Arsenic, bromides (confluent), chloral hydrate, iodides (isolated), salicylic acid.

Purpura.—Chloral hydrate, chloroform inhalation, iodides, quinine, salicylic acid.

Pityriasis rubra (?).—Bichromate of potassium.

Psoriasis (?).—Borax, bichromate of potassium.

Eczema.—Bicarbonate of potassium, bromides, chrysarobin, iodoform.

Gangrene.—Arsenic, ergot, iodides, quinine.

Persistent desquamation.—Quinine.

Abscess.—Quinine.

Furuncles.—Arsenic, bromides, quinine.

Keratosis palmaris.—Arsenic.

Pigmentation.—Arsenic, nitrate of silver, picric acid.

Herpes Zoster.—Arsenic.

H. Radcliffe Crocker.

DRY.—Synon.: Fr. *Sec*; Ger. *Trocken.*—A term applied to certain morbid conditions, to express the entire or comparative absence of fluid exudation or secretion, which is often present in such conditions; for example, Dry Gangrene, Dry Cavity, Dry Catarrh, and Dry Pleurisy. The word is also associated with certain auscultatory signs, which convey the impression of want of moisture; for example, Dry Rhonchus and Dry Crackle. *See* Physical Examination.

DUCHENNE'S PARALYSIS.—*See* Pseudo-Hypertrophic Muscular Paralysis.

DUCTUS ARTERIOSUS, Patency of.—*See* Heart, Malformations of.

DUMBNESS.—Definition.—The condition of an individual considered incapable of articulating sounds.

Dumbness may arise from a variety of causes, and its prognosis and treatment vary accordingly.

1. **Dumbness due to deafness.**—The most frequent cause of so-called dumbness is congenital or early acquired complete deafness, or defective power of hearing, so that the patient is unable to acquire in an ordinary way the knowledge of articulate sounds. It is important to bear in mind that complete deafness is not essential to this peculiarity. Dumbness is frequently met with in children and others where the only cause is *defective* power of hearing.

Treatment.—Whether the outcome of complete or partial deafness, the treatment must be based on the belief that the articulating power is latent, and may be developed by teaching the patient to imitate the process of speaking in others, and by a methodical training in lip-language. It is most important that sign-language should not be cultivated at the same time, and that if a language of signs, whether by the hand or gesture, has been previously taught, it should be thoroughly and at once discarded. With patients who have full intellectual power, and who are trained as indicated above, it will be found that for them dumbness is a misnomer, articulate sounds, although with a defective modulation, being readily acquired. Individuals coming under this category are erroneously called deaf-mutes.

2. **Dumbness from central lesion of the hypoglossal nerve.**—This may arise from cerebral hæmorrhage, tumours, or embolism, and the prognosis is most unfavour-

able. It is usually associated with other paralytic conditions, but is of all the most persistent.

3. **Dumbness from peripheral lesion of the hypoglossal nerve.**—This is much less frequent as a cause of dumbness than central lesions; nevertheless cases are met with where hydatid or other tumours result in dumbness through pressure on the nerve itself.

4. **Dumbness from lead-poisoning.**—Among the paralyses arising from the slow effects of imbibition of lead is paralysis of the tongue, with consequent loss of articulating power. This defect is usually associated with grave impairment of other parts.

TREATMENT.—The treatment of dumbness due to lead-poisoning will be best effected by elimination of the poison by the administration of iodide of potassium, and the judicious employment of galvanism to the nervous system.

5. **Dumbness from congenital defects of the tongue or of the palate.**—Various congenital local lesions are met with giving rise to dumbness.

TREATMENT.—Many of these cases are remediable by surgical or surgico-dental help, followed by methodical teaching.

6. **Dumbness from emotional lesions.** Dumbness occasionally arises from great emotional disturbance, such as great anger or sudden fright. Moreover, it is often met with, without such marked cause, in individuals, especially of the female sex, having a highly developed emotional life.

TREATMENT.—Cases of this kind are usually successfully treated by faradisation about the muscles of the neck; the patient at the same time being encouraged to call his articulating power into action, and in proportion to his success the faradic current being discontinued. The moral treatment here indicated may be greatly assisted by promoting the general health, and placing the patient under the best possible circumstances as to hygiene and moral discipline.

7. **Dumbness from intellectual disorders.**—This is by far the most common cause of true dumbness. It may arise from idiocy or imbecility of a congenital nature; from that which has been acquired early in life; or from dementia as the outcome of acute or chronic brain-disease in middle or advanced life. Among the congenitally feeble-minded, dumbness is a very frequent phenomenon. This arises from the association therewith of deformed mouths and highly-arched palates; from defective power of co-ordination of the muscles of the tongue; and from an inability to transform ideas into word-signs. In the most profound cases there is such an absence of ideas that language of any kind is not required.

TREATMENT.—The treatment of this kind of dumbness is one which requires great tact, patience, and energy; and the success will be commensurate with these aids.

The physical health of the individual should be carefully attended to, so as to induce, by judicious food, frequent bathing, and warm temperature, the highest amount of nervous energy. The power of co-ordination should be sedulously cultivated by methodical exercises, especially of the hands, leading up to well-devised tongue-gymnastics. He should then be taught monosyllabic sounds, by being shown the object represented by the sound, while he imitates the sound when watching the teacher's lips. Having thus acquired the power of producing the word-sign by imitation purely, he is next taught to repeat it from memory when shown the object only. After nouns have thus been taught, the names of qualities and adverbial expressions should be added, and in this manner articulate speech built up.

Where the feeble-mindedness has been acquired after birth, the dumbness resulting therefrom should be treated in a somewhat similar manner to that having a congenital origin, but the prognosis is not so good.

Still more unfavourable is the forecast of dumbness when the result of dementia.

J. LANGDON DOWN.

DUODENUM, Diseases of.—These may be considered under the heads of—(1) *Functional disorder*; and (2) *Organic diseases*.

1. *Functional disorder.*—Disorder of the duodenum is said to produce a form of dyspepsia, characterised by pain in the epigastrium and right hypochondrium two or three hours after meals, vomiting, and the distant effects of ordinary dyspepsia—vertigo, headache, drowsiness, burning sensation in the soles of the feet and palms of the hands, &c. Imperfect chymification, which attends ordinary dyspepsia, may induce these symptoms by generating products which irritate the duodenum.

TREATMENT.—The treatment is mainly that of disordered digestion. The bowels and the diet are to be carefully regulated; and such remedies as alkalis, bismuth, oxide of manganese, prussic acid or hydrochloric acid exhibited, according to the special requirements of each case.

2. *Organic diseases.*—These are (*a*) *inflammation*; (*b*) *ulceration*; and (*c*) *new-growths*.

(*a*) **Inflammation.**—SYNON.: Duodenitis; Fr. *Duodénite.*—*Acute* inflammation of the duodenum is usually of a mild catarrhal character. It either forms part of an enteritis, or is an extension downwards of a similar affection of the stomach. The ordinary exciting causes are exposure to cold, and irritating ingesta or acrid bile. Usually the symptoms of slight gastric catarrh—a loaded tongue, anorexia, nausea, vomiting of tenacious mucus—are followed by jaundice. When the duodenum is invaded there is said to be fulness and tenderness of the right hypochondrium. As a rule, however, new symptoms are not set up unless the bile-ducts become obstructed by mucus from extension of the catarrh into them, when jaundice supervenes without pain. The attack usually lasts a week or a fortnight, and, with suitable hygienic and dietetic treatment, it passes safely off. It is, however, sometimes followed by jaundice unusually prolonged, and, even when the bile-ducts are free, by prostration and wasting out of proportion to the mildness of the disease in itself. While catarrhal duodenitis does not afford characteristic symptoms, its presence is, however, usually suggested by painless jaundice following exposure to cold, catarrh of the stomach, and enteritis.

Treatment.—This consists in rest in bed, warmth, liquid diet, counter-irritation by blisters, mustard or hot poultices, and effervescing salines.

Chronic inflammation, resulting in thickening of the mucous and submucous tissue, and even adhesion of the duodenum to adjacent organs, is usually associated with chronic ulceration, or with cancer of the duodenum, pancreas, liver, or other structures. Contraction of the duodenum produces symptoms of obstruction similar to those arising from stricture of the pylorus.

(*b*) **Ulceration.**—*Perforating ulcer*, similar to that of the stomach, is said to be more frequent in men than in women (about 10 to 1), and rarely to occur during childhood; while it sometimes follows severe and extensive burns and scalds.[1] Fatal ulceration has not infrequently been reported in previously healthy subjects. It may then possibly arise from an accidental abrasion of the duodenal mucous membrane (by some indigestible substance), becoming subsequently subjected to the deleterious action of the gastric juice.[2] The ulcer, usually single and found in the upper horizontal portion, when recent has clean-cut edges free from swelling. The wall of the duodenum may be perforated, either without previous adhesion, being followed by the signs of general peritonitis; or with adhesion to adjacent parts, such as the liver, the gall-bladder, the pancreas, the colon, the hepatic artery, or the posterior wall of the abdomen—into which ulceration extends to a variable extent. Cicatrisation may take place with recovery, or it may induce stricture of the duodenum or obliteration of the bile-duct. As a rule the symptoms greatly resemble those of perforating ulcer of the stomach; more frequently, however, the disease is latent, and induces very obscure dyspeptic symptoms prior to fatal perforation. Jaundice is not more common than in the similar affection of the stomach. In burns and scalds perforation seldom occurs before the tenth day. The treatment should be the same as that laid down for gastric ulcer. *See* Stomach, Diseases of.

The duodenum may be ulcerated by the action of a gall-stone passing into it directly from the gall-bladder.

(*c*) **New-Growths.**—The most important of these is scirrhous cancer, which may involve the walls of the duodenum, usually by extension. It tends to produce obstruction, or it may set up chronic duodenitis, or block up the bile-duct and thus give rise to jaundice.

George Oliver.

DURA MATER, Diseases of.—*See* Meninges, Diseases of.

DURATION OF DISEASE.—*See* Disease, Duration of.

DYNAMOMETER (δύναμις, power; and μέτρον, a measure).

Description.—The dynamometer is an instrument originally invented by M. Duchenne, of Boulogne, for measuring and accurately recording the strength of the hand-grasp, and also for measuring the traction power capable of being exerted by other groups of muscles. The result is shown by an index, which traverses a semicircular dial bearing a scale graduated so as to enable the observer to record the number of kilogrammes which the applied pressure or traction represents. In practice this instrument has been principally employed for estimating the absolute or comparative force of the hand-grasp; and, in view of this restriction, Duchenne's instrument is needlessly complex. It has, moreover, the absolute disadvantage of being a little too broad, and of requiring too much strength on the part of the patient to move the index over the lower figures of the dial. A patient with a small amount of motor power, especially if the hand is small, is often unable to set the index of this dynamometer in motion. A cheaper, simpler, and narrower instrument has therefore been devised by English makers, the index of which can be moved by the application of a much smaller amount of power. This consists of a simple elliptical ring of steel, to the inner and anterior face of which is attached a brass semicircular dial graduated with two rows of figures representing pounds instead of kilogrammes. The compression of the steel ring, by lessening its shorter diameter, moves a metal bar projecting from and sliding in a groove behind the dial, and this by rack-work communicates its movement to the index.

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[1] In explanation of the connexion between severe burns and duodenitis ending in perforative ulceration, Dr. William Hunter infers from his experiments with the subcutaneous injection of toluylendiamin (which he found to set up inflammation of the duodenum) that there may be derived from the burnt tissues and excreted through the bile irritant substances which excite ulcerative inflammation. Some recent observers (Fayrer, Bowlby, and Perry), however, have failed to discover *post-mortem* evidence of the alleged causal relation between burns and duodenal ulceration; while others (Wilks and Macarthy) have shown the rarity of it. Doubtless the association is much less frequent than has hitherto been held; for example, Raymond Johnson found in the records of University College Hospital only two cases of ulceration out of ninety-three cases of burns (*Trans. Path. Soc. Lond.*, 1890).

[2] Myers, *Trans. Path. Soc. Lond.*, 1890.

Uses.—The dynamometer is a useful instrument, inasmuch as it enables us accurately to ascertain the relative compressing powers of the two hands in cases of incipient or actually developed hemiplegia, and also to learn in a positive and definite manner, from time to time, the amount of improvement or the reverse which may have taken place. Since the power of the muscles of the forearm and hand, like that of other groups of muscles, varies a good deal with the general state of health of the patient, the dynamometer is also capable of yielding valuable information concerning the strength of the patient, even where we have to do with general debility from any cause rather than with a case of paralysis. Any instrument which, in the place of fleeting and more or less vague impressions made upon the mind of the practitioner at the time, enables him to make a more accurate record in figures in his note-book, is a clear gain to practical medicine—more especially when its use involves no appreciable loss of time.

H. Charlton Bastian.

DYSÆSTHESIA (*δυσ-*, with difficulty; and *ἀισθάνομαι*, I feel).—A term applied to impairment of any of the senses, but especially to that of touch. *See* Sensation, Disorders of.

DYSCRASIA (*δυσ-*, with difficulty, or badly; and *κρᾶσις*, a mixture).—A morbid condition of blood.

This term signifies more than a disposition to disease; it implies the presence of some general disease exerting its pernicious effects upon the blood. Hectic fever, septicæmia, and metastatic inflammations are diseased conditions referable to dyscrasiæ. A person sickening for a fever is the subject of a specific dyscrasia. *See* Blood-Disease.

R. Douglas Powell.

DYSENTERY (*δυσ-*, with difficulty; and *ἔντερον*, an intestine).—Synon.: Fr. *Dysenterie*; Ger. *Dysenterie*.

Definition.—A specific febrile disease, accompanied by considerable nervous prostration, and characterised by inflammation of the solitary and tubular glands of the large intestine; sometimes ending in resolution, but frequently terminating in ulceration, occasionally in more or less sloughing or gangrene; always, in the acute stage, accompanied by tormina and tenesmus, the latter being most marked when the disease is situated in the rectum or lower end of the sigmoid flexure; stools at first more or less fæculent, later on yielding dysenteric products without much if any fæculence, such as blood, mucus, slime, and gelatinoid exudation, or—as in the sloughing or gangrenous forms—like the washings of meat, and possessing a putrid or gangrenous odour, and so-called epithelial, ash-coloured, black, gangrenous, pus-infiltrated or tubular sloughs, chiefly consisting of tough, imperfectly organised exudation.

Ætiology and Pathology.—In almost all, if not in all, situations where malarious fevers abound, as in the vicinity of the swamps and sluggish rivers of tropical and sub-tropical countries, dysentery prevails in proportion to the intensity and frequency of these fevers. Where, on the other hand, intermittents and remittents have been extinguished by improved drainage and the conversion of marsh into cultivated land, it becomes equally unknown. In or near the tropics, Great Britain, Canada, the United States, and in many other parts of the world, its diminution has proceeded *pari passu* with the decrement of malarious fevers. There would, therefore, seem to be some intimate connexion between the causation of dysentery and intermittent and remittent fevers. Not that the immediate causes of malarial fevers and dysentery are identical: all that is meant is that under certain conditions they concur.

Paroxysmal fevers interfere materially with the nutrition and functions of the digestive organs, and with the proper nourishment and constitution of the blood. Violent congestion of the abdominal viscera is one of the special conditions of the different forms of ague. Both the liver and spleen are liable to temporary and repeated engorgement, and so in fact are all the organs which minister to gastric and intestinal digestion. Even where malarious poisoning may never have resulted in any of the various forms of periodic fever, it may impair the power of the organic nerve-centres and the muscular tone of the blood-vessels, thus disturbing the balance of the portal circulation, and leading to more or less permanent repletion or congestion. As the congestion is most embarrassing during digestion, interfering with the appetite, and the capacity for digesting and assimilating food, its repeated and prolonged existence must deteriorate the quality and modify the quantity of such important secretions as the gastric juice, the bile, the pancreatic juice, and those furnished by the follicles of Lieberkühn, and by Brunner's and the solitary glands. Crude alimentary principles are thus assimilated from the intestinal tract. The liver is especially liable to functional derangement from the stagnation and slowing of the portal circulation, and thus it happens that in dysentery hepatic impairment is almost an invariable accompaniment. Such being some of the abnormal conditions produced by the operation of malaria in its active or latent form upon the chylopoietic viscera, it is not surprising that, under the prolonged strain, certain portions of the alimentary mucous membrane should break down. Why the solitary glands of the large intestine should be the special seat of dysentery, whilst the corresponding glands in the small intestine should, with few exceptions, escape, it is, in the present state of our knowledge, impossible to say. The most that can be hazarded is, that the elementary structures of these glands take on morbid action through the operation upon them of a *materies morbi* derived directly from their blood-supply. That this poison exists in the blood may be inferred from the fact that constitutional disturbance invariably precedes and accompanies the earlier stages of acute dysentery.

Unwholesome drinking-water is a fertile proximate and exciting cause of dysenteric disease. Bad and unwholesome food of whatever description, by providing aliment incapable of being perfectly digested, may act in producing the disease. In like manner impure air may, by preventing the proper aëration and depuration of the blood, and by promoting the retention in it of inassimilable material, light up dysenteric inflammation of the solitary glands. The transit of acrid and vitiated bile and other secretions poured into the digestive canal, often operates as an exciting cause, and frequently determines a morbid action which might be otherwise righted by resolution, to advance to ulceration, sloughing, or gangrene. It is thus that many a simple but neglected case, scarcely at first distinguishable from diarrhœa—unless indeed every evacuation is most carefully washed and scrutinised—ends in destruction of large masses of the mucous membrane, and death, from the conjoint effect of exhaustion and shock from the separation of the sloughs. Indigestible articles of diet, which cannot be reduced by the juices of the digestive tract to a condition admitting of ready absorption, may act as local irritants and exciting causes. Not only is this so in the earliest visible stage or that of active congestion, but it becomes much more susceptible of demonstration in the exudative and ulcerative phases of the disease, by the repeated investigation of the subjective and objective indications. Thus the aggravation of the tormina and tenesmus in adults and children is traceable to indiscretion in diet, or to the passage of undigested morsels of food, recognisable in the stools. Sudden vicissitudes of temperature from a high to a low range, or exposure to damp and cold combined, especially when the vital powers are physiologically depressed, by checking the excretory action of the skin and diminishing the cutaneous circulation, augment the portal congestion and excite dysenteric disease. This is probably the reason why, in a large proportion of cases, the onset of the disease is ushered in towards midnight or the early morning. The operation of epidemic influences in the causation of dysentery, signifies only that it is most prevalent at those seasons when malarious fevers are most abundant. As there is an intimate connexion between the existence of malaria and the prevalence of dysentery, it is not difficult to understand why, both as regards type and seasonal frequency, dysentery should bear a striking relation to the severity and seasonal prevalence of malarious fevers.

Is dysentery a contagious or communicable disease?—Whilst many of the older physicians held that dysentery might be spread by contagion from person to person, it may be affirmed that the experience of most modern practitioners is altogether opposed to this view. There is no clear and unimpeachable evidence to demonstrate that it is propagated in the same way as typhus or small-pox. Dysentery may possibly be communicable, like typhoid fever, through air, water, or food—liquid or solid—charged with material derived from the undisinfected and putrefying products of the disorder. Be this, however, as it may, the complete disinfection or destruction of the alvine evacuations should always be regarded as a sanitary measure of supreme importance.[1]

ANATOMICAL CHARACTERS AND PATHOLOGY.—The dysenteric process generally consists of a specific inflammation of the solitary glands (Parkes, Baly, and others). The *first* visible change is congestion, the vessels surrounding and penetrating the capsules being turgid and engorged with blood. The *second* change is augmentation of their contents from the accumulation of albuminous exudation, and enlargement 'from the size of a millet-seed to a small shot' (Baly). The *third* change, provided the inflammation advances, is rupture of some of the capillaries in the interior of these little vascular glands, extravasation of blood, with the area of the ordinary dark point on the free aspect increased. The *fourth* stage is now marked by atrophy and molecular disintegration of the free aspect of the capsular wall, and escape of its morbid gelatinoid blood-tinged contents into the canal of the intestine. This is the rule; but, in very exceptional cases, the capsule may burst through the attached portion, lighting up inflammation in the neighbouring connective tissue and muscular coat. In a large number of instances the morbid process may stop short, under proper treatment, at any of the first three stages, and repair is then effected by resolution. In many cases the morbid action is cut short after the completion of the fourth stage, without further extension of the disease. The adjoining follicles of Lieberkühn do not, in these cases, necessarily participate, to any great extent, in the diseased process. Under these conditions, when the whole of the exudation has been expelled, the glands regain their tone and functions, and recovery—rapid and complete—ensues. It is not often possible to illustrate these conditions in the *post-mortem* room; because, when death supervenes from dysentery alone, the ravages committed upon every structure of the mucous membrane are so extensive as to destroy the earlier physical phases of the disease. In some cases, however, which have died from intercurrent affections, the writer has been able to demonstrate the earliest stages successfully to his students, at a period prior to the implication of Lieberkühn's follicles, of which the mucous membrane is in great part composed, and to exhibit to them the gelatinoid exudation, termed by others 'gelatinous mucus,' free from or tinged with blood taken from enlarged and diseased solitary glands (*Indian Annals of Medical Science*, p. 190, No. xxiii., 1868).

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[1] It is more than probable that there are several varieties of dysentery, each of which is attributable to its own specific cause. Different micro-organisms have from time to time been described in this connexion; but, as there seems to be no consensus of opinion on the subject among observers, it is premature to conclude that dysentery is brought about by the direct action on the glands of the colon of any known micro-organism. The only parasite which has established anything like a claim to be considered specific to dysentery is the *Amœba coli*, discovered by Lösch in 1875. This amœba has of late years been frequently found in dysenteric discharges in places so widely separated as Russia, Central Europe, Egypt, the United States of America, and India. Moreover, it has been found, on more than one occasion, in the pus and walls of liver-abscess complicating dysentery. This association is not without significance; but, as the amœba is certainly not present in every case of dysentery or dysenteric abscess of the liver, we are as yet justified in regarding it mainly as an epiphenomenon grafted on certain cases of colitis and liver-abscess, and not as the specific cause of these diseases. The *Amœba coli*, which when alive displays the characteristic amœboid movements, varies in size from 0·02 to 0·035 mm., is coarsely granular, nucleated, and possesses one or more non-contractile vacuoles. *See* ENTOZOA.—EDITOR.

When, owing to neglect, to constitutional defect in spite of the most careful therapeutic and hygienic management, or to intensity or quantity of the specific poison, the disease is not cured by resolution, the disintegrating or ulcerative process is developed. The whole of the solitary glands engaged perish. The ulceration involves the neighbouring tubular glands, leading to ulcers varying from the size of a mustard-seed to that of a florin or more, in depth generally extending to the submucous connective tissue, and not infrequently laying bare the circular lamina of the muscular coat, sometimes involving the longitudinal layer and perforating it as well as the peritoneal coat, thus admitting of the extravasation of the contents of the bowel into the peritoneal cavity, and lighting up peritonitis, which, if general, is invariably fatal, but which, if local and confined to the close vicinity of the perforating ulcer, is not necessarily so.

The ulcers vary in appearance, size, and shape. They may be mere abrasions without much loss of structure; *minute*, though penetrating rather deeply into the submucous connective tissue; *irregular*, *serpentine*, or *rodent*, with here and there portions of the surrounding mucous membrane undermined and patulous; *transverse*, embracing partially, or completely, the entire circular outline of the mucous membrane; *circular* or *oval*, with regular and even margins; or *tubercular*, involving the whole substance of the mucous membrane, looking as if they had been punched out of it. These ulcers, as generally observed in the *post-mortem* room, are free from sloughs, and present a pale ashy appearance. Sometimes they are of a vermilion or purple colour, from active or passive congestion. They are often covered with flakes of tenacious lymph or exudation, and this may sometimes be seen spread over the neighbouring mucous membrane. The floors of these ulcers are usually formed by inflamed and thickened submucous areolar tissue; but sometimes this has all been destroyed, and then they are constituted of the muscular coat, thickened and infiltrated by inflammatory products; and when the muscular structure has itself yielded to the ulcerative process, they are made up of congested and swollen peritoneum, which, as already stated, occasionally becomes perforated.

When the ulceration proceeds solely by molecular disintegration massive sloughs are not observed. But when, as not uncommonly happens in asthenic, malaria-stricken, tubercular and worn-out constitutions, tissue-death occurs *en masse*, at an early period of the attack, sloughing of the mucous membrane is to be seen, together with portions of the muscular coats, or gangrene. These sloughs, or gangrenous portions of tissue, may be limited in extent. Some or all of them may be successfully detached during life, and can be identified as they are examined from time to time in the stools. In the *post-mortem* room they may be found partly detached and lying loose, mixed with the fluid contents of the bowel, or attached more or less firmly; sometimes compact, nodular, ecchymosed, grey or olive-coloured, green or yellow and pus-infiltrated, black, flaky, shreddy, shaggy, flocculent like pieces of teased cotton-wool, or ragged and stringy. In the truly gangrenous dysentery, the mucous and muscular coats are enormously thickened, and large portions are found gangrenous, varying in colour from a pale olive to purple or black. These appearances and conditions may be restricted to the cæcum and ascending colon, or to the sigmoid flexure, but sometimes they are co-extensive with the internal structure of the large intestine from the ileo-colic valve to the anus.

When the ileo-colic valve becomes destroyed, invagination of the lower end of the ileum into the cæcum sometimes happens, causing intestinal obstruction. Occasionally many inches of the gangrenous mucous membrane, with or without the muscular coat, are found either hanging loose in the lower part of the gut, or in process of being detruded from the anus.

In ordinary acute dysentery, advancing to ulceration or sloughing, repair is doubtless accomplished, as a general rule, by granulation and cicatrisation. This process can be readily observed in dysenteric lesions of the mucous membrane of the lower end of the rectum, and in healing of the surgical ulcer within the verge of the anus. The reason why repair is frequently accomplished so slowly is because, owing to the irritation caused by the exalted vermicular contraction of the gut and the passage of flatus, fæces, and other products, it is impossible to command the physiological rest necessary for speedy and substantial granulation and cicatrisation. Unless the destruction of tissue is very great, the contraction due to cicatrisation does not occasion much future inconvenience. But if it embraces a large portion or the whole circumference of the mucous membrane, the subsequent contraction may produce dangerous narrowing of the calibre of the gut, or stricture of the sigmoid flexure or rectum. The thickening and contraction, especially in the attenuated victims of chronic dysentery, can be identified by physical examination. These constrictions are frequently the mechanical cause of constipation and fæcal accumulations.

There is no valid reason for believing that the lost tissue is ever actually reproduced in true dysenteric ulceration. When the ulcers have been small, the contraction following repair is sufficient to bring the follicles of Lieberkühn on all sides into close juxtaposition. And this it is which has given rise to the impression among some pathologists, that the lost tissues have been renewed by a process of development and growth. But whenever the ulcers have been too large to admit of obliteration, microscopical examination shows that they have been bridged over by cicatricial tissue, devoid of solitary and tubular glands, and sparingly supplied with blood-vessels and absorbents.

In addition to the above anatomical characters, the mesenteric glands are generally found to be enlarged; and as an accompaniment or sequel, organic disease of the liver, or abscess, is not infrequently discovered to complicate the disease.

Symptoms.—Every attack of acute dysentery is preceded by disordered digestion and constitutional disturbance, indicated by loss or capriciousness of appetite and furred tongue, constipation alone or alternated with looseness, dryness of skin, occasional chilliness and general malaise, with slight rise of the evening temperature. These signs may be viewed as contemporaneous with the progress of the morbid action going on in the solitary glands. As the disease advances, there is more marked chilliness, succeeded by distinct feverishness. If the bowels have been confined, they now act spontaneously—expelling, at one or more acts of defæcation, almost the whole of the contents of the large intestine. If they have been loose, with or without aperient medicines, the fæculence is not so great in quantity. But in either case, beyond a little mucus, there is not as yet any discoverable dysenteric product in the stools. Prior to this conservative evacuation of the bowels, the febrile excitement sometimes runs high; there is thirst, bad taste in the mouth, flatulency, a variable amount of nervous and muscular debility, griping, an accelerated and irritable pulse, restlessness, disturbed sleep or actual insomnia. During, and immediately after, each evacuation there is tenesmus or painful straining—most intense in those cases where the disease is situated in the descending colon, sigmoid flexure, and rectum. The stools are offensive, but there is nothing at this stage pathognomonic in their odour. If, as frequently happens in private practice, the patient comes under treatment at this period, a small dose of castor oil guarded by laudanum, or a full dose of ipecacuanha, with absolute rest in bed and bland liquid nourishment, is sufficient, in a certain proportion of cases, to put a stop to the morbid action, and to promote cure by resolution in from twenty-four to forty-eight hours.

When, however, the disease persists, the symptoms continue in an aggravated form. The tormina and tenesmus become intensified; the desire to go to stool is more frequent, and to remain on the stool or bed-pan more irresistible and enduring, especially if the disease be concentrated in the sigmoid flexure or rectum. In rectal dysentery, there is dysuria, frequent micturition, and sometimes retention, from spasm due to reflex action, necessitating catheterism. The consumption of solid food—even of the most digestible kind—provokes and aggravates the tormina. The griping and tenesmus are now so intensified in degree, and increased in frequency, that each recurrence of them produces much depression and exhaustion, and a pinched and anxious expression of the countenance, with augmented frequency and weakness of the pulse. There is abdominal tenderness. During the acme of the tormina, the patient experiences difficulty in localising this tenderness. He will then declare that he feels agonising pain over the greater part of the abdomen, with or without the application of pressure. But in the absence of the tormina, careful palpation will enable the practitioner to localise it in those portions of the intestine above the rectum which are affected by dysenteric inflammation. At this stage the tumefaction of the walls of the gut is seldom great enough to be distinguished through the abdominal parietes. The scanty stools are now characteristic, consisting of mucoid exudation tinged with blood, or bloody mucus or slime from the inflamed tubular glands, with isolated portions of gelatinoid exudation, more or less coloured with blood from inflamed and ruptured solitary glands, and with little or no fæculence. These conditions are contemporaneous with the rupture of the affected solitary glands and a highly inflamed state of the adjacent follicles of Lieberkühn, as well as of the subjacent and intervening connective tissue. The muscular tissue, though not yet necessarily inflamed, is nevertheless hyperæsthetic. It is this hyperæsthesia which has more to do with the production of the agonising tormina than the diseased glandular organs implanted in and forming a constituent portion of the mucous membrane. These are the symptoms presented in a goodly number of cases met with in private practice, and in a smaller proportion admitted into hospital. The disease is said to have lasted from two to six or eight days. In uncomplicated cases, occurring in tolerably good constitutions, they generally yield, without extension of the mischief, to rest, bland liquid food, and full doses of ipecacuanha.

In cases which have been neglected or aggravated by indiscretions in diet and drink, or by diathetic or other defect of constitution, the dysenteric process passes on to ulceration. If the patient have not been brought under proper therapeutic and hygienic management, the tormina, tenesmus, local tenderness, and hardening of the superimposed abdominal muscles are augmented. The calls to stool are more frequent and painful. The urine is scanty and high-coloured, and is surcharged with lithates and biliary pigment. The stools mainly consist of the foreign products already described, but in greater quantity; are now possessed of a peculiar sickly smell; and yield portions of exudation in masses of greater or smaller size, simulating sloughs, but which, on microscopical examination, are seldom found to afford positive evidence of dead tissue-elements.

Unless the disease bend to treatment, it may terminate in sloughing. This may be either restricted or extensive. Death of portions of the mucous membrane is always accompanied by vital depression or well-defined muscular and nervous prostration, cardiac enervation, and an accelerated and feeble pulse. In some cases tissue-death *en masse* happens at an earlier period, even before the rupture of the solitary glands; and the sloughs can be discovered in the stools on from the eighth to the thirteenth day. The acme of vital prostration is manifested during the detachment of the sloughs, when the exhaustion is often much increased by hæmorrhage. Improvement in the strength, volume, and slowing of the pulse, and in the expression of the countenance, the comparative relief from tormina and tenesmus, cleaning of the tongue, and the substitution of fæculence for dysenteric products in the stools, signify, in these cases, the probable cessation or turning-point of the disease. The converse implies that the sloughing is extending, and a succession of sloughs of various kinds, with or without muscular structure, continues to be passed, which, in the process of separation, is accompanied by much bleeding, especially in patients poisoned by malaria or afflicted with the scorbutic or hæmorrhagic diathesis. The abdominal tenderness and hardening of the parietal muscles are marked during the separation of the sloughs. The affected portions of the colon can be felt to be swollen, doughy, and 'puddingy' (Chevers). The skin, in unfavourable cases, becomes clammy, features and eyes shrunken, body emaciated, appetite in abeyance, thirst great and distressing, tongue dry and brown, pulse feeble and running; the stools extremely offensive, bloody, slimy or watery, with varieties of sloughs and exudation. The sensibility becomes so blunted that the stools are passed without much pain —often involuntarily; and the patient eventually dies from sheer exhaustion from the extension of the sloughing, or the end may be accelerated by perforation of the bowel in one or more places, leading to extravasation of some of the contents of the intestine into the peritoneum, and general peritonitis.

Sometimes, from the commencement of an attack, or during the course of acute dysentery, rapid sloughing forms the chief pathological condition, passing into gangrene of large patches of mucous membrane, attended by increasing prostration and soon merging into collapse. As this extends until, in many instances, it involves almost the whole of the mucous membrane, submucous tissue, and muscular structure, it is characterised by intensified collapse. The tormina and the tenesmus, at first excruciating, suddenly disappear, to the delusive relief of the sufferer. Until the gangrene has spread to a great extent, the stools contain a large quantity of slime, blood, peculiar-looking exudation, and much gelatinoid exudation; but as the living mucous membrane becomes diminished, these products also decrease, and, in their room, we notice a watery product of a dark purple or black colour, resembling the washings of meat, giving off an incomparably offensive and gangrenous odour. To the naked eye, and on washing, these stools seem to be absolutely devoid of fæculence. They yield a granular sediment of a black colour—gangrenous *débris* blackened by the combination of sulphur with the iron of disorganised cruorin. The abdomen, at first doughy, becomes tympanitic and free from pain on pressure, and the surface cold and clammy; the countenance resembles the haggard and sunken appearance presented during the algid stage of cholera; the tongue is dry, brown, and fissured; the pulse is thready and rapid; food and medicines are rejected; the dejecta are passed involuntarily; perception is blunted; delirium supervenes; and the patient at last succumbs, worn out and exhausted, on from the sixth to the thirteenth day, according to the range and severity of the disease, and the constitutional power which he possesses.

Chronic Dysentery.—This is sometimes the result of acute dysentery, in spite of the most appropriate management, in persons poisoned by malaria and weakened by fatty or waxy degeneration of the spleen or liver, or both, and in strumous or scorbutic constitutions. The dyscrasia may be so pronounced that the material exuded is incapable of healing up the ulcers by granulation and cicatrisation. The ulcers are repeatedly disturbed by peristalsis and the passage of flatus, fæces, undigested morsels of solid food, and the acrid unutilised secretions of the liver, stomach, and pancreas. Thus they are liable to become irritable from renewed congestion and inflammation. The muscular coat participates in the excitement, and becomes infiltrated with exudation, which eventually becomes organised and leads to thickening. The floors and sides of the ulcers are constituted of unhealthy structure. The difficulty thus experienced in effecting repair is augmented. In other cases the intestine becomes atrophied, attenuated, and transparent. The stools are made up of serous exudation, slime, blood, and sometimes of puriform material, with fæculence generally unformed. Almost every stool will be found on washing to contain dysenteric products. Very frequently, especially in cases which have been carefully dieted for a time, neither blood nor mucus can be detected in the stools, which appear to be of a purely diarrhœic nature. The appetite is uncertain; the tongue often clean, shining, and devoid of epithelium; the pulse weak and irritable; and the abdominal tenderness easily localised. Thickening can often be detected. Tormina are always present; and unless the disease be confined to the cæcum or ascending and transverse colon, there is tenesmus. Multiple abscesses of the liver frequently supervene and carry off the patient; or after months or years of suffering he may perish from inanition and exhaustion, or from intercurrent disease.

Complications.—Acute dysentery is frequently complicated by the various forms of malarious fever, typhoid fever, the tubercular or the hæmorrhagic diathesis, purpura, scurvy, hepatic and splenic enlargement, malarious cachexia, or abscess of the liver; and in children by dentition. In every case of dysentery the strictest attention should be paid to existing complications. In patients inhabiting marshy districts, and those following a seafaring life, the gums should be carefully scrutinised, and the cutaneous surface examined, with a view to ascertain the freedom or otherwise from purpuric or scorbutic taint. The history of the patient should be gone into, in order to make out the probable diathetic proclivities—acquired or hereditary.

Sequelæ.—That abscess of the liver, single or multiple, frequently follows acute and chronic dysentery, is indisputable; but whether as a result of the general condition existing, or of local pyæmic poisoning or embolism originating in the veins within the area of the ulcers, is still an open question. Dysentery sometimes terminates in permanent thickening of the parietes of the gut with eventual contraction or stricture, causing constipation, fæcal accumulation or obstruction. When the seat of stricture can be reached, as in the lower part of the rectum, much relief can be afforded by simple incision and subsequent dilatation by means of bougies. Fissure of the anus, or ulcer within the verge of the anus, is a common sequel. Once diagnosed by examination of the stools and by means of the speculum, it admits of speedy relief by incision and after-surgical management.

Diagnosis.—Dysentery can be diagnosed from diarrhœa by the abdominal tenderness, tormina, tenesmus, and the existence of dysenteric products in the stools. Dr. Edward Goodeve, late Professor of Medicine in the Calcutta Medical College, was the first to carry out the practice of washing the stools in dysentery and diarrhœa. The stools are first examined as they lie in the stool-pan. Water is then added in considerable quantity. After a short interval, to allow the dysenteric products to sink to the bottom, the supernatant fluid is gradually poured off. The washing is repeated until the foreign products remain clean and destitute of much smell. When these products are putrescent, or perhaps in all cases, it is convenient to wash the stools with a solution of carbolic acid or other colourless disinfectant. Dysentery is diagnosed from *fissure or ulcer of the rectum* by the fluid or loose character of the stools, with dysenteric products, and by the absence of ulcer, as determined by examination by means of the anal speculum.

Prognosis.—*Favourable.*—The following are to be regarded as favourable features in the prognosis of any given case: The ordinary uncomplicated form of acute dysentery; early subsidence of the constitutional disturbance; a steady, firm, and strong pulse, with diminishing frequency and increasing power; moderate abdominal tenderness; absence of tympanites; a placid and normal expression of countenance; absence of sloughs or putrescent matters in the stools; early subsidence of tormina and tenesmus, with the appearance of fæculence and the contemporaneous decrease of dysenteric products; return of appetite and power of digesting and assimilating food; and the absence of inflammatory or suppurative mischief in the liver.

Unfavourable.—Unfavourable features, on the contrary, are—The persistence of an elevated temperature; quick pulse, with increasing feebleness; sudden freedom from tormina, tenesmus, and abdominal tenderness, with great vital depression or collapse; doughy thickening of the colon, with dulness on percussion where there should be resonance; sudden increase of abdominal tenderness, with hiccough, nausea, vomiting, and great nervous prostration, tympanites, and peritonitic pain with constant hardness and tension of the abdominal muscles; increase of putrescent and gangrenous products in the stools, like the washings of decomposing flesh; excessive hæmorrhage from the bowel; bleeding from chapped and fissured lips, gums, and mouth; harsh, dry, black or glazed tongue; delirium; picking at the bedclothes; and scantiness or suppression of urine.

Treatment.—Should an aperient be required in the congestive, exudative, or ulcerative stages of acute dysentery, or in sudden relapses supervening upon chronic forms of the disease, the readiest, simplest, and most painless is a tepid water enema of from two to four pints. After the operation of the enema, or immediately the patient presents himself suffering from any of these dysenteric conditions, in those cases where no preliminary aperient is indicated, a turpentine epithem or mustard plaster should be applied to the epigastrium for twenty minutes. At the same time, from twenty grains to a drachm of ipecacuanha, suspended in two drachms of syrup of orange-peel and four drachms of water, or in half an ounce of infusion of chamomile, with ten grains of carbonate of sodium or bismuth, or simply made up into conveniently sized pills, should be administered. The recumbent posture, with the head lower than usual, should be enforced. Liquids should be resisted as much as possible for an hour or two. Food should not be given for at least three hours before, and six hours after, the administration of the drug. Movement of every kind must be avoided; and the saliva should not be swallowed, but wiped away with a cloth. Thirst may be quenched by sucking pieces of ice, or, when this cannot be procured, by cold water in teaspoonsful at a time. Nausea will probably occur; perhaps, in some cases, retching and vomiting. When vomiting does occur it seldom happens before the lapse of an hour after the exhibition of the drug, and the ejected matter usually consists of small quantities of gastric secretion. Should the ipecacuanha be rejected, the dose should be repeated as soon as the stomach has been tranquillised. It will be found beneficial to time the large doses, so as to allow of one being given night and morning, as long as their use is considered necessary. The signal for the relinquishment of these doses is freedom from tormina and tenesmus, with the occurrence of refreshing sleep, fæculent, bilious, or ipecacuanha stools, and restoration of the primary processes of assimilation. If no great amount of disorganisation of the mucous membrane have taken place, these favourable changes are frequently noticed after the administration of the first or second dose; and even if undoubted ulceration have set in, they are generally discerned on the second or third day, or earlier. In either case the drug should be abandoned, as the disappearance of the tormina and tenesmus, and the absence of mucus, blood, and slime from the stools, indicate the cessation of dysenteric inflammation, and that the affected portions of the bowel have been placed in the most favourable condition to undergo cure by 'resolution,' if the case have not proceeded to ulceration, or by 'granulation and cicatrisation,' if ulceration or even sloughing have already taken place. Chalk-mixture with hyoscyamus and astringents is now quite sufficient to complete the cure. In some cases ferruginous and bitter tonics are demanded, to give tone to the digestive organs, and to improve the condition of the blood. Counter-irritation, by means of turpentine epithems and mustard plasters to the abdomen, or fomentations, is a valuable adjunct in the management of the disease.

The diet should consist of chicken-broth, beef-tea, essences of chicken, mutton, or beef; sago, arrowroot, or tapioca; and small quantities of good port wine or brandy. During the active period of the disease all food should be given in a liquid form. The disturbing effect of the ipecacuanha given as above directed is only temporary. Abundance of time is, therefore, available between the large doses for the digestion and assimilation of liquid food. At the outset of dysentery, and as long as the tongue is coated, food should be avoided as much as possible; and when taken it should consist of very weak chicken-tea or barley-water. As soon as the tongue is clean a purely milk diet is the best. As the stools become more fæculent and consistent, solid food in the shape of tender chicken, lamb, and mutton, with biscuit and bread, light sago, rice, or tapioca pudding should be allowed. Potatoes and other vegetables should be avoided until the tone of the digestive system has been fully re-established. When the dysentery is complicated with a purpuric or scorbutic condition of the blood, the administration of the juice of the grape, orange, pomegranate or lime, and bael sherbet, are essentially necessary as dietetic rather than therapeutic agents.

Opium by the mouth is seldom required. When swallowed it 'locks up' the secretions of the liver, pancreas, and alimentary mucous membrane, rather favouring than reducing the inflammation of the solitary and tubular glands. These bad effects counterbalance the benefits derived from the sleep, diminution of peristaltic action, and temporary decrease of tormina and tenesmus consequent on narcotism. This explains why the real character of the disease is often completely masked by opium, and why apparent amendment is taking place whilst destructive ulceration and sloughing of the mucous membrane is rapidly extending. As ipecacuanha speedily brings about all the good without any of the evil effects of opium, this narcotic is not only superfluous but injurious in any form, excepting as an enema or suppository to relieve tenesmus, particularly in sigmoidal or rectal dysentery. There is less objection to uniting the ipecacuanha with such remedies as are acknowledged to possess the power of lessening the irritability of the stomach, and of increasing its tolerance of the drug, without interfering with the functional activity of those organs whose secretions we are endeavouring to promote with a view to rectify the disturbed balance of the portal circulation. On the contrary, medicines of this order may be beneficially associated with ipecacuanha—such as carbonate of sodium, bismuth, chloroform, camphor, and hyoscyamus.

When dysentery occurs in pregnant women, large doses of ipecacuanha are not contra-indicated; because, if the disease be allowed to proceed (which is more likely to happen under the old than the ipecacuanha treatment) abortion or premature labour is almost certain to follow; and when such a complication supervenes, in the later months of gestation, the mortality almost surpasses that of any other disease. When the dysenteric inflammation is summarily put a stop to by the ipecacuanha, abortion or premature labour is prevented. Under the opiate method of management, premature labour is not averted, but, in the majority of cases, occurs at the acme of the disease, when the sloughs are being thrown off; and the patient succumbs to the conjoint shock to the system. In dysentery complicated with pregnancy opiate enemata to relieve irritation in the rectum are more essential and permissible than under other circumstances.

In the acute dysentery of children ipecacuanha is invaluable. For a child of six months a grain, and for a child of one year two grains, should be given, with an equal quantity of carbonate of sodium, night and morning, until the tormina, tenesmus, and slimy and bloody stools are replaced by relief from pain and by fæculent evacuations. It will not often be necessary to continue the drug beyond two or three days at a time. But it should be remembered that the disease adheres with greater tenacity to children than to adults; and although we observe that ipecacuanha has an immediately beneficial effect in diminishing the blood, mucus, slime, and frequent stools, still we find that dysenteric or slimy motions with undigested food continue to pass. In that case the ipecacuanha, combined with chalk, bismuth, carbonate of sodium, or aromatic powder, should be repeated, once or twice a day, for a certain period, till healthy evacuations are restored. The gums must be lanced when necessary; turpentine liniment or stupes may be applied to the abdomen; weak chicken-broth or arrowroot should be temporarily substituted for milk; and, above all, food must be given in small quantities at a time, and at regularly stated periods. From the age of one year the dose is regulated by adding one grain for each additional year of age up to eighteen, when the doses indicated for adults should be employed.

In cases where evident malarious taint pervades the system and complicates acute dysentery, sulphate of quinine is indispensably necessary. A scruple of the antiperiodic will be most speedily absorbed if dissolved in water acidulated with sulphuric acid, and the exhibition of this may precede by an hour the first dose of ipecacuanha. Ten-grain doses should be given midway between the large doses of ipecacuanha, or during abatement of febrile excitement, until the feverish symptoms have been subdued. Quinine here is quite as important as ipecacuanha, for, until it has successfully checked the disturbing influence which malarious poisoning exercises upon the capillaries of the portal and general circulatory systems, the good effects which ipecacuanha produces are only temporary and incomplete. The mildest febrile exacerbations of a miasmatic origin re-excite dysenteric action, and thus undo the good effected by the action of the ipecacuanha. Hence the urgent necessity for removing without delay every vestige of masked or active malarious fever complicating dysentery. No drug enables us to accomplish this object so safely and so quickly as the sulphate of quinine in large doses.

When ipecacuanha fails to preserve the life of the patient, its failure may be generally attributed to—(1) coexistence of abscess of the liver; (2) unchecked malarious poisoning; (3) permanent enlargement of spleen or liver, or both; (4) irretrievable constitutional cachexia; (5) Addison's disease of the supra-renal capsules; (6) morbus Brightii; (7) phthisis or tuberculosis; (8) strumous disease of the mesenteric glands; (9) peritonitis, with or without perforation of the gut; or (10) the existence of extensive sloughing or gangrene.

The *advantages* of the 'ipecacuanha treatment' (for the revival of which the profession in India and England is indebted to Mr. Scott Docker, of the 2nd battalion of the 7th Royal Fusiliers, stationed at the

Mauritius,—*Lancet* of July 31 and August 14, 1858) in the congestive, exudative, and ulcerative stages of almost every form and type of acute dysentery, as well as in the acute attacks supervening upon chronic dysentery, may be briefly stated. They consist in (1) its simplicity, (2) its safety, (3) its certainty compared with any other method, (4) the promptitude with which the inflammation is stopped, (5) the rapidity with which repair takes place —(*a*) by resolution or (*b*) by granulation and cicatrisation, (6) conservation of the constitutional powers, (7) abbreviation of the period required for convalescence, (8) decrease in the frequency of chronic dysentery, (9) decrease in the frequency of abscess of the liver, (10) diminution of mortality to cases treated—all of which are accomplished, (*a*) without local or general blood-letting, (*b*) without salivation, (*c*) without calomel and irritating purgatives, and (*d*) without opium by the mouth.

Ipecacuanha in large doses may be said to fulfil many important indications. It produces: (1) all the benefits that have been ascribed to blood-letting without robbing the system of one drop of blood, (2) all the advantages of mercurial and other purgatives without their irritating action, (3) all the good results of antimonials and sudorifics without any of their uncertainty, (4) all the euthanasia ascribed to opium without masking, if not aggravating, the disease whilst the mischief is silently accumulating within. Thus, we possess in ipecacuanha a non-spoliative antiphlogistic, a certain cholagogue and unirritating purgative, a powerful sudorific, and a harmless sedative to the heart and the muscular fibres of the intestines.

The *objections* which have been urged against large doses of ipecacuanha in dysentery are, first, its 'depressing influence' kept up by nausea and vomiting; and, secondly, that it is liable to set up 'uncontrollable vomiting.'

First, the depressing power, nausea, and vomiting have all been over-estimated. Nausea is only a temporary and evanescent effect. Vomiting is an exceptional occurrence; and even when it does supervene, it seldom lasts long. As much nourishment, therefore, as may be required to support the strength can be given in the intervals between the large doses of ipecacuanha. But what contributes more to the conservation of the patient's stamina and to the prevention of depression or asthenia, is the speedy cessation of the dysenteric process accomplished by the drug, followed by refreshing sleep and the power of digesting and assimilating nourishing food. Such remarkable results as these soon reconcile any patient suffering from dysentery to an otherwise disagreeable remedy.

Secondly, when uncontrollable sickness and vomiting succeed the employment of this drug in the manner already recommended, the existence of one or other of the serious conditions previously enumerated may be more than suspected. In the absence of these complications, unmanageable vomiting is seldom if ever witnessed. Hence, in a preponderating majority of the cases of dysentery met with this objection is quite untenable. The truth is that every physician who has used ipecacuanha in heroic doses soon learns that depression of the vital powers from it is not to be feared, and is surprised at the small amount of vomiting that follows its administration, and at the unexpected ease with which the stomach tolerates its presence.

When dysentery becomes *chronic* no time should be lost in counselling removal from a malarious to a non-malarious and mild climate. A sea voyage—provided easily digestible food can be secured—is often attended by the happiest results. To men so afflicted 'the salt ration,' as remarked by Dr. Maclean, 'is simply destruction.' The clothing should be warm, and flannels always worn round the abdomen; Dr. Maclean also recommends 'the use of a water belt over the abdomen for some hours daily. This acts as a fomentation, and the steady uniform pressure it maintains seems to favour the absorption of the fibrin effused between the intestinal coats. If there be much uneasiness about the fundament, a water compress over the anus affords more relief than opiate enemata.' The food should be chiefly concentrated soups, milk and lime-water, and sago, cornflour, arrowroot, &c., egg-flip with port, sherry, or brandy; or, if solid food can be digested, the tenderest chicken, lamb, or mutton, with bread and biscuit, may be allowed. Beyond airing in a carriage or chair, no exercise should be attempted. The position should generally be recumbent or semi-recumbent. The erect position excites peristaltic action, and thus disturbs the physiological rest required to facilitate the repair of the ulcers. Antiscorbutic juices should be given where there is the least taint of scurvy or purpura. Frequent blistering does much good; and all forms of counter-irritation are beneficial. In all obstinate cases a diet consisting of milk only ought to be tried; and also enemata of a solution of nitrate of silver ($\frac{1}{2}$ grain to 1 fl. oz. of distilled water), two or three pints being passed up whilst the patient is in the knee-shoulder position and the pelvis well raised.

Gallic acid, acetate of lead, sulphate of copper, and nitrate of silver, are reputed to act beneficially. Dr. Maclean's favourite remedy, 'particularly in men returning from tropical regions, anæmic from loss of blood and the depraving influence of malaria, is the solution of the pernitrate of iron. Under this remedy the whole system often rallies wonderfully, the condition of the blood improves, colour returns to the blanched cheek, the stools become more natural and less frequent, the appetite improves, and digestion is more perfectly performed. The citrate of iron and quinine may after a time be substituted.' As nearly all chronic cases are underlain by a malarious taint, quinine should form an important element in the therapeutic management, and the greatest care should be taken to secure for the residence of the patient a climate at once mild and temperate and free from suspicion of malaria. Bathing during convalescence is an efficient and welcome auxiliary. Tepid or warm baths, medicated with Tidman's sea-salt or with nitro-muriatic acid, act in stimulating the secreting function of the skin. But it will often happen that, in spite of the most careful dietetic, hygienic, and therapeutic management, no substantial progress towards the repair of the ulcers is made, and the patient eventually dies, worn out from suffering and the asthenia consequent literally on inanition.

JOSEPH EWART.

DYSIDROSIS (δυσ-, with difficulty; and ἱδρώς, sweat).—*See* SUDORIPAROUS GLANDS, Disorders of.

DYSMENORRHŒA (δυσ-, with difficulty; μήν, a month; and ῥέω, I flow).—Difficult and painful menstruation. *See* MENSTRUATION, Disorders of.

DYSOREXIA (δυσ-, with difficulty; and ὄρεξις, the appetite).—An obsolete term for impaired or depraved appetite. *See* APPETITE.

DYSPEPSIA (δυσ-, with difficulty; and πέπτω, I concoct).—A synonym for indigestion. *See* DIGESTION, Disorders of.

DYSPHAGIA (δυσ-, with difficulty; and φάγω, I eat).—Difficulty in swallowing. *See* DEGLUTITION, Disorders of.

DYSPHONIA (δυσ-, with difficulty; and φωνή, the voice).—Difficulty in producing vocal sounds, so that the voice is more or less enfeebled. *See* VOICE, Disorders of.

DYSPNŒA (δυσ-, with difficulty; and πνέω, I breathe).—Difficulty of breathing. *See* RESPIRATION, Disorders of.

DYSURIA (δυσ-, with difficulty; and οὐρέω, I pass water).—Difficult or painful micturition. *See* MICTURITION, Disorders of.

E

EAR, Diseases of.—SYNON.: Fr. *Maladies de l'Oreille*; Ger. *Ohrenkrankheiten.*

The natural division of the ear into external, middle, and internal, suggests a rational as well as a convenient classification of the disorders to which the auditory apparatus is liable.

I. EXTERNAL EAR.—In examination of the external meatus and tympanic membrane, bright diffused daylight, or, when this is not obtainable, light from a bull's-eye lamp lit with gas or electric light, is the best for illumination, and the light should be reflected from a concave perforated mirror of eight-inch focus down a tubular speculum. In any operative proceedings the mirror should be worn on the forehead, as in examining the throat, but otherwise should be held in the hand. As great variations in the calibre of the auditory meatus are met with, it is necessary to be provided with specula of several sizes, the most convenient form being that known as Gruber's.

Of the affections of the external ear the most important are the following:—

1. **Eczema.**—Although the acute form of eczema occasionally affects the auricle and external auditory meatus, it is far more common to meet with the chronic variety. Elderly females are especially subject to eczema of the ear, and it is to its long continuance that the remarkable narrowing of the external meatus throughout its whole extent, met with occasionally in the subjects of this complaint, is generally attributable. Such narrowing will often amount to almost complete closure, and it is in these instances that eczema becomes the cause of greatly impaired hearing; for when this condition is arrived at, the passage down to the tympanic membrane is at times so small as only to admit of a very small probe. It is for this reason that, although no special methods of treatment are called for, beyond what is necessary when parts other than the ear are affected with eczema, it is of the greatest importance to keep the meatus sedulously free from secretion, and this occasionally is not a very easy matter.

2. **Changes in cartilage.**—Another condition, in which the external passage becomes subject to partial closure, is shrinking of the cartilaginous part of the meatus. This, again, is a complaint of old age, and is attributable to no known cause. It is readily relieved by the patient wearing a piece of silver tube, to keep the passage patent.

3. **Bony Growths.**—Bony growths in the external auditory canal are of two kinds, true exostoses and hyperostoses.

(1) *True exostoses* arise from the junction of the osseous and cartilaginous portions of

the canal, owe their origin to acute inflammation, and are somewhat rapid in their growth. They present very little difficulty in their removal, inasmuch as they are attached by a pedicle, and are not composed of very dense tissue.

(2) *Hyperostoses* arise from the osseous part of the canal. These growths are of ivory hardness, and have a large base. They are occasionally single and confined to one ear, but generally are multiple, and more usually than not affect the meatus of both ears simultaneously. The form which they habitually assume is that of three growths, the apices of which meet, or nearly so, in the axis of the canal. Thus, seeing that a very small opening is quite enough to permit of the passage of sonorous vibrations to the tympanum, their presence remains undiscovered until a minute piece of cerumen completely closes an already nearly closed canal, and so by the deafness thus produced leads to their detection. Their growth is very slow, as they are observed to remain without increase for many years, and although without doubt they are at times congenital, it would seem that their existence is often called into being by a local irritation, first, because in a large number of cases the individuals so suffering have been for long periods addicted to diving; secondly, they are frequently preceded by a discharge passing for years through a perforated membrane and over the canal.

TREATMENT.—The occasions when these growths should be removed ought to be strictly limited to two conditions: 1st, when they interfere with the escape of purulent discharge, and so place the patient in danger of cerebral inflammation; 2nd, when by absolutely closing the canal they induce great deafness. In the large proportion of cases the occasional removal of cerumen which blocks up the small opening that remains is all that is necessary, and this should be done by the use of a small hook rather than by syringing, as the passage of water behind the growths is to be avoided. When, however, it is imperative to remove bony growths for either of the above-named reasons, the best method consists in drilling them away with a dental engine, to which may be attached drills of various shapes and sizes. This operation should be performed under reflected light, and ether must be given. Owing to the extreme hardness of the growths, this process occupies considerable time, but with due care it is not a dangerous proceeding. When the object in view is simply the relief of deafness, it is sufficient to drill away the apices of the growths, but when it is done for the purpose of providing a complete escape to purulent matter it is desirable to remove the chief part of the enlargement.

4. **Inflammation.**—The external auditory meatus is subject to inflammation, diffused or circumscribed, the latter occurring in the form of small abscesses or boils. Both affections are attended by acute pain, and in each the general health of the patient has been out of order for some time previous to the local trouble.

TREATMENT.—Treatment in the direction of improving the general health, and local bleeding by means of leeches applied in front of the tragus, will often rapidly relieve the diffused form of inflammation; but when it has continued for a long period (as it not infrequently does), in addition to the soft tissues the periosteum becomes affected. The passage then throughout its whole extent becomes so swelled as to nearly close the external opening, and pain is constant. The only treatment which gives complete and permanent relief under these circumstances is to make two or three free incisions down to the bone, along the whole extent of the osseous part of the canal. A convenient instrument for this purpose is a small sharp-pointed curved bistoury. As to the propriety of opening abscesses in this situation there can be no question, for, owing to the extreme denseness of the tissues and their approximation to bone in the external auditory canal, abscess in this part is slow in its progress and attended with very great suffering. These abscesses being especially liable to recur, a proper regimen and medicines appropriate to the failure in general health are required.

5. **Fungi.**—The external auditory meatus has been occasionally found to be the seat of two varieties of vegetable fungus, namely, *Aspergillus flavus* and *nigricans*. The symptoms which they have given rise to have been great irritation and a slight discharge. They have been readily destroyed by syringing, and the local application of diluted spirit of wine or weak mercurial ointment.

6. **Polypus.**—Polypus of the ear is usually preceded by inflammation in the tympanic cavity and perforation of the membrane; it is considered along with diseases of the *middle ear*.

7. **Hæmatoma Auris.** *See* HÆMATOMA AURIS.

II. MIDDLE EAR.—All affections of the middle ear originate in some part of that tract of mucous membrane which, commencing where the Eustachian tube opens into the pharynx, forms the lining of this tube and of the cavity of the tympanum, finally becoming the innermost layer of the tympanic membrane. To the character of this tissue is due the term 'catarrh,' which, in its two forms of purulent and non-purulent, is used in describing any deviation from health which, directly or indirectly, is the cause of pathological change in the Eustachian tube or tympanum.

1. **Obstruction of the Eustachian Tube.**—One of the most frequent conditions under which the Eustachian tubes become

the seat of obstruction is that met with in children or young persons. The subjects of this affection present a very characteristic aspect. They breathe almost entirely through the mouth, which, sleeping or waking, is kept partially open; their tonsils are often enlarged, and they snore loudly during sleep. The mucous membrane of the nares and pharynx is swollen, and secretes in excess. Owing to this tumid state of the fauces the passages to the Eustachian tubes in this situation do not admit of the constant necessary supply of air to the tympana. The air in these cavities undergoes partial absorption, and thus becomes more rare than that external to the tympanic membrane; the density of the outer air remaining the same, the equilibrium from pressure is destroyed; the membrane, consequently, is retracted, the chain of ossicles is pressed inwards, and thus the conduction of sound becomes interfered with—in short, the patient is more or less deaf. In these cases inspection of the tympanic membrane at once reveals the state of affairs. As the cavity of the tympanum is not involved in the catarrhal change, its translucency and lustre are not impaired; the handle of the malleus is tilted inwards, the head of this bone is unusually prominent, and there is a distinct fold crossing the upper part of the posterior section of the membrane. Where the obstruction has lasted for a long period, the membrane will appear to be almost fallen in upon the walls of the tympanum, and the promontory and incus may be distinguished. If under these conditions the tympanum be inflated on Politzer's plan,[1] an instant return to good hearing follows, but in the course of a few days the improved hearing partially dies away, leaving the patient, however, in some degree better than before the operation.

In all these cases a thorough examination of the pharynx should be made, inasmuch as it will be frequently found that the symptoms above mentioned are due to masses of adenoid growths in the vault of the pharynx. This condition is especially indicated when, in addition to the apparent nasal obstruction, the intonation of the voice is of that peculiar kind as of a person speaking with a bad cold: thus—"dinety-dine" instead of "ninety-nine." The only effectual way to explore the pharynx is to place the forefinger behind the soft palate as far up as the posterior nares. When adenoid vegetations are present, they can in this way be readily felt, and their size and position estimated. The posterior nares will often be found to be completely closed, and in severe cases the pharynx throughout is absolutely filled with them. A rhinoscopic examination gives but a very inadequate idea of the condition.

Treatment.—When adenoid growths are present they should be removed, and if this is done thoroughly the patients recover their hearing completely in the course of a few weeks, and what is almost of equal importance (this applies to the general health), nasal respiration is quite restored. The best plan is without doubt to clear the pharynx at one sitting. This may be done either under ether, or without. In each case the patient's body should be well bent forward, in order that the blood should pass out through the nostrils. Unless this position is carefully attended to in the case of a patient under ether, there is great risk of blood dribbling into the larynx and being inhaled; for, these growths being very vascular, there is a good deal of bleeding. With this precaution, however, the pharynx can be cleared of adenoid growths by the nail of the forefinger in cases where they are very soft and friable; or in other cases (the larger proportion), when they are of firmer consistence, by the use of a steel nail (introduced to notice by the writer), adjusted to the forefinger. When it is found upon examination that adenoid growths are not present, the treatment of obstruction of the Eustachian tubes will be of a more simple character. It should include the gentle syringing of the inferior nares with warm alkaline solutions. The most useful of these contain bicarbonate of sodium and borax. In using them the head should be bent forward, and a small nasal syringe employed; this is preferable to the nasal douche, since the stream from the douche is so powerful as sometimes to rush into the Eustachian tubes, and so excite inflammation of the tympanum. Politzer's inflation should be employed, but not more frequently than two or three times in a week.

If the tonsils are so much enlarged as to interfere with the respiration, it will be necessary to remove them; but the reason for this proceeding is not that they press upon the openings of the Eustachian tubes, but because their presence keeps up the unhealthy condition of the pharynx.

Under this routine of treatment the patients completely recover their hearing; the space of time during which it is necessary to continue treatment varying according to the obstinacy which each case manifests.

Obstruction of the Eustachian tubes in *adults* presents certain well-marked differences from the affection as it prevails in *children*. An ordinary cold is the beginning of the trouble. It is more usual to find one instead of both tubes obstructed, and more often than not the tympanic cavity is involved in the catarrh. Where this is not the case—and it will be evident from the retained lustre and transparency of the membrane—the same principles of treatment as are pursued in the case of children will hold good, except in so far that the affection in grown-up persons is less persistent after the tube has been once artificially opened; and that, to effect this, Politzer's method is sometimes not sufficient, or, even if so, not as efficacious as the Eustachian catheter. It must also be borne in mind that in the treatment of cases in which one ear is healthy, by means of the catheter the affected ear exclusively may be subjected to the air-douche, whilst with Politzer's method it is impossible to avoid forcing a stream of air into the healthy tympanum, and this is not always an advisable proceeding.

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[1] This method of inflating the middle ear (now in such general use) consists in passing a stream of air from an india-rubber bag through one nostril whilst the patient swallows some water. The operator at the same time closes one nostril with the forefinger of the left hand, and completes the closure of the other with the thumb. The mouth must be kept firmly shut.

The Eustachian Catheter.—The following is the mode of using the Eustachian catheter: 'Place the patient in a chair, and let him lean back, and steady his head with the left hand firmly fixed on the top of it; hold the catheter lightly in the right hand, with the curve downwards, and pass it quickly in this position through the inferior meatus of the nose to the posterior wall of the pharynx. When this is felt, withdraw the catheter about half an inch, and tilt the point of the curved end rather upwards, and to the left or right, according to the side which is being operated upon. Now hold the catheter and end of the patient's nose steadily between the thumb and the first two fingers of the left hand. All this time the ear of the patient and that of the surgeon are connected with the otoscope. The point of the catheter is now supposed to be in the pharyngeal orifice of the Eustachian tube; but the only certain sign of this being the case is that when air is forced into the catheter it will be heard through the otoscope to impinge upon the tympanic membrane when a stream of air is passed down the catheter.'

The catheter may be made of silver or of vulcanite, but, of whatever material, it must be inflexible whilst being used. Beyond this, suffice it to say here that in practised hands its employment is invaluable, and indispensable in the treatment of most affections of the middle ear, not only in overcoming obstruction of the Eustachian tube, but also as a means by which injection of fluids may be applied to the cavity of the tympanum. In making use of the air-douche an india-rubber bag fitted to the catheter should be employed, and in using injections to the tympanum a similar arrangement is necessary.

2. Catarrhal Inflammation of the Tympanum.—When the tympanic cavity has become involved in the catarrhal state, or when the affection, instead of proceeding up the Eustachian tubes, begins in the tympanum, as it frequently does, those changes have commenced which, of all others, form the most frequent impediments to the conduction of sound—in other words, which make the subjects in whom they are found more or less deaf; and it may be broadly stated that the extent to which this affection is remediable depends directly upon the time at which the patients suffering from it apply for treatment. In the early stages, the obstruction to the passage of sound through the tympanum is solely due to the effusion of mucus in this situation, and this is easily demonstrated by the moist gurgling sound which inflation of the tympanum produces, as may be heard upon connecting the ears of the patient and surgeon by means of a piece of india-rubber tubing.[1] Afterwards comes what may be termed the dry stage, *i.e.* when the fluid portion of the mucus has suffered absorption, and when any of the products of inflammation may have become more or less organised, or at least in a condition which, if not interfered with, suffers no further change. The morbid conditions which result from non-purulent catarrh of the tympanum are twofold. First, those which affect the tympanic membrane, and are, therefore, demonstrable during life; secondly, those which are met with after death in the tympanic cavity. The first of these include changes in curvature, in colour, and in consistence.

The slighter changes in curvature have been noticed in speaking of obstruction of the Eustachian tubes, which condition is necessarily more or less present in all cases where the tympanum has been the seat of catarrh, and these changes are met with indefinitely increased until the state of complete collapse is reached.

In this condition the membrane has the appearance of being in close apposition to the walls of the tympanum, and lapped round the ossicles, so that the forms of the malleus, incus, and sometimes the stapes are distinctly traceable.

In so extreme an example, the membrane is generally bound down to the tympanic wall by adhesions. The first change which the membrane exhibits is a loss of its lustre and transparency: it becomes opaque. Further alterations in colour, in cases of long standing, consist in the formation of patches of brown, yellow (colour of parchment), and white. Variations in consistency will include thickening throughout the membrane, or in parts of it, especially in the cases of dense chalk deposits (phosphate of lime); and thinning in places, so observable sometimes that inflation will induce bladder-like protrusions, which, as inflation is suspended, fall back again: changes in all these respects completely metamorphosing the appearance of the membrane. After death, within the tympanum may be found collections of dried mucus around the ossicles; thickening of the lining membrane; bands of adhesion in all directions; and ankylosis of the ossicles to each other, as well as between the stapes and fenestra ovalis.

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[1] This tubing should always be used, whether air or fluids are being injected through the Eustachian tube, for upon the sounds thus heard, as well as on the patient's own perception, depends the answer to the question whether the inflation is complete.

As additional evidence during life of obstruction in the tympanum, it may be mentioned that sounds from a vibrating tuning-fork placed on the vertex are intensified when such obstruction exists, and the nerve remains unimpaired. This test is especially valuable where one ear is healthy, inasmuch as the sound will be heard exclusively on the deaf side, this being due to the fact that vibrations of sound thus conveyed to the auditory nerve, on their passage outwards through the tympanum, meet with the obstruction in this position, and are reflected on to the labyrinth. The appearances above described, together with the history of the case, serve sufficiently to distinguish affections of the conducting from those of the nervous apparatus; and the sounds which are produced upon inflation of the tympanum, whether of a moist or dry character, give evidence as to whether the mucus in the cavity of the tympanum is in a more or less fluid state, or has reached the dry stage where the fluid part of the secretion has become absorbed, the more solid portion remaining.

TREATMENT.—In the first of these conditions, the inflation at once increases the hearing power; in the second, it produces no change in the hearing. An indication in this direction is a most useful guide in respect of treatment, which may be said to include injections of fluid or vapours into the cavities of the tympana. In the matter of the selection of these remedies, the greatest diversity of practice exists in the hands of capable authorities. Astringent solutions of sulphate of zinc, alkaline injections of bicarbonate of sodium, iodide of potassium, chloride of ammonium, and the vapours of iodine, chloride of ammonium, each and all find favour. If fluids are injected, a few drops only are to be introduced through the Eustachian catheter, a small bulb of india-rubber being used to force the fluid through the catheter. Vapours are employed by means of the many apparatus in general use. The diversity of opinion on this subject shows how difficult a problem is the treatment of the ulterior effects of catarrh of the tympanum.

The degree of improvement varies within wide limits, but the greater benefits may always unhesitatingly be predicted during the moist stage of the catarrh. Indeed, the necessity for early treatment is abundantly shown, in the instance of catarrhal affection of the middle ear, by the extremely satisfactory termination of cases treated early in the disease, and the slight relief which but too often follows when the affection has been allowed to proceed for years unchecked. In such cases as the latter, the fact that considerable quantities of inspissated mucus have been found in the tympanic cavities, first suggested the operation of making an incision into the tympanic membrane, and attempting the removal of mucus through the incision by passing a stream of air through the tympanum. This proceeding, with certain modifications afterwards introduced, is no doubt very useful in cases favourable for its employment, but it should be reserved for those which have defied the less severe means, and where there is unmistakable evidence of an obstruction to the passage of sound through the tympanum. Experiments with the tuning-fork, already referred to, give valuable evidence in this direction; but for a detailed account of this method of treatment, introduced some years ago by the late Mr. Hinton, the reader is referred to *Questions of Aural Surgery*. Suffice it to say here that an incision about one-eighth of an inch in length is made in the posterior section of the membrane with a cataract-needle, and through this opening an attempt is made to expel from the tympanum the morbid secretion. It is not within the compass of this article to refer to the many operations which have during the past fifteen years been suggested for the relief of tympanic affections, but as in most of these cases there is no doubt that the mucous membrane which lines the tympanic cavity is the primary seat of the disorder, not sufficient success has attended these efforts to stand the test of time, or probably some of them would be practised habitually by aural surgeons in this country, on the Continent, and in America. Such, however, is not the case. One of the causes of failure in all operative measures on the tympanic membrane is to be found in the fact that it is impossible to keep any opening in this structure from healing. That such attempts at relief should have been made is not surprising when it is remembered how intractable some of these cases are, how one of the forms of catarrh which affects the tympanum is slow and insidious in its progress, and sufficiently distinctive in its character, to have applied to it by general consent the term *proliferous progressive catarrh*.

3. Purulent Catarrh of the Tympanum.—Perforation.—The form of tympanitis in which the effused products become purulent, is an acute and generally an extremely painful affection. Usually the pus rapidly makes its escape from the tympanum into the external meatus, by a process of ulceration through the tympanic membrane, leaving as its result a perforation of this structure. In quite the early stage the affection may often be cut short by the free application of leeches in front of the tragus, followed by fomentations, but more often than not the membrane has given way before the patient comes under observation. Even then, if the tympanic cavity be emptied of the pus by the free use of Politzer's inflation and repeated syringing, the opening will often close, and leave very little, indeed sometimes hardly any, appreciable deafness. If, however, a purulent discharge through the opening be allowed to go on unheeded for any length of time, it is the exception for the perforation to heal. This condition is constantly seen after scarlet fever, measles, or any of the exanthemata. A perforation of the tympanic membrane presents an infinite variety of aspects, from a small pinhole to nearly complete loss of the membrane, but there will always be a slight remaining external rim of membrane. This latter is perhaps the most frequent of all forms of perforation, and especially when the ulceration dates from an attack of scarlet fever. Although the handle of the malleus occasionally remains, it more usually comes away in these and other cases where the loss of tissue is very extensive. The head of this bone, however, may always be distinguished, unless there has been complete disorganisation of the tympanic cavity. Among other forms of perforation commonly met with may be mentioned those in which the anterior or posterior half of the membrane is left, and is bounded internally by the handle of the malleus; the so-called *reniform* perforation, where the lower part of the membrane is lost, and the umbo of the malleus indicates the position of the hilus of the kidney; and the small, smooth-edged circular perforation which is common alike to all parts of the membrane. Occasionally, though not very often, the tympanic membrane is the seat of a double perforation. Similar variations in hearing accompany this condition, between slight deafness and total loss of hearing power. The size of the perforation affords no guide in this respect, extreme loss of hearing being met with when the perforation is very small, and very slight deafness where the loss of tissue has been most extensive, so that it may be unhesitatingly stated that the loss of the membrane is but in a very small degree the cause of the deafness in these cases, the disorganisation in the tympanic cavity mainly accounting for this. Such disorganisation is at times so complete (especially after scarlet fever) as to include the loss of all the ossicles, total deafness, and paralysis of the muscles supplied by the portio dura. A very small perforation in the anterior and superior part of the membrane may from its position escape notice, but the diagnosis can be always verified by the facility with which air may be made to pass through the opening, or the reverse, provided that the communication between the Eustachian tube and the tympanum is not closed by cicatricial tissue—a very rare condition when so little of the membrane has suffered ulceration.

One other form of perforation deserves mention, rather on account of its frequency than its importance, namely, perforation of Shrapnell's membrane, which is that part of the membrane proper lying just above the short process of the malleus. Ulceration of this small area, which is merely a protective membrane, may exist without any impairment to hearing so long as the remainder of the tympanic membrane is entire, so that it would appear to perform no function so far as a conducting medium is concerned, but it is important to bear in mind that when it is perforated the lesion is at times connected with exposed bone.

TREATMENT.—The treatment of purulent tympanitis and perforation will include assiduous cleanliness; keeping the Eustachian tube free from obstruction; and the use of local remedies. Amongst the most useful of these are weak solutions of alcohol, and insufflation of gallic acid or boric acid. As the condition of the ear improves under these measures, so will the hearing power vastly increase when it has not been completely lost; but there still remains the ofttimes invaluable application of what is spoken of as the *artificial* membrane. Of all kinds, the best undoubtedly is the flattened pad of moistened cotton-wool, applied by the patient, every morning, with a pair of forceps constructed for the purpose. Until this be tried in each case it is impossible to say whether it will do good; but when it is useful—as it is in a large number of cases—by its help the patient will recover very good hearing, and this even when the perforation has existed for a period of many years. That its effects depend upon the support which it gives to the ossicles, thus re-establishing the normal pressure of the stapes upon the fenestra ovalis, has been unquestionably demonstrated.

4. Polypus.—One of the most frequent complications in cases of perforation of the tympanic membrane is polypus, a term employed to designate a fleshy tumour in the ear. Although polypi are occasionally present in the meatus independently of perforation, the most usual situation from which they arise is the lining membrane of the tympanum. Sometimes the exact point of origin is the edge of a perforation, and still more rarely the sides of the meatus. In size these growths vary from a small protrusion through a perforation, to a tumour which entirely fills the meatus and projects externally from the ear. In this latter instance the growth presents a very distinctive appearance, not unlike a raspberry. Sections of aural polypi hardened in chromic acid with few exceptions show the structure to be fibro-cellular, the fibrous element preponderating over the cellular in proportion to the age of the tumour.

TREATMENT.—In all cases polypi should be removed, and the best instruments for this purpose are the rectangular ring polypus forceps, or, in the case of a large growth, a Wilde's snare. Owing to their remarkable tendency to recur, removal is only the preliminary step in treatment. The principal part of this consists in their complete eradication by caustics. Of these the most efficacious and convenient is chloro-acetic acid, and later in the treatment nitrate of silver. The acid should be applied with great care by using it on the point of a probe defended by a small twist of cotton, and a convenient form of nitrate of silver is a bulb of the melted salt fused on to a probe or platinum wire. The caustic should be applied daily for some time after the polypus has been removed, and then less frequently. The treatment should also include the same scrupulous cleanliness and application of astringents, so desirable in the case of perforations. It is simply to the want of attention to details that failure in the treatment of aural polypus may be ascribed.

COMPLICATIONS OF TYMPANIC DISEASE.—(*a*) *Facial Paralysis.*—This is due to inflammation around the portio dura in its passage through the aqueduct of Fallopius. When suppuration in the tympanic cavity, with caries of the bony canal, precedes or accompanies the loss of function in the nerve, recovery is hopeless; but when the paralysis follows a subacute catarrh of the tympanum, not ending in a perforation, as is sometimes the case, the paralysis in time disappears no less certainly than when it is dependent upon an affection of the nerve at a point after its exit from the temporal bone.

(*b*) *Pyæmia; Cerebral Abscess;* and *Meningitis.*—When the mastoid cells become the seat of inflammation, the pain, tenderness, and pitting on pressure over the mastoid process, will at once suggest an early incision down to the bone, and it may be truly said that this is often delayed too long, and perhaps is never done too soon. Again, when the symptoms point definitely to pus within the mastoid cells, the bone should be pierced so as to make the external opening communicate freely with the cells. Relief given in this way will occasionally be the means of saving life, by preventing the absorption of poisoned material into the lateral sinus. Besides pyæmia thus induced, other fatal issues which suppuration in the middle ear frequently entails have their starting-point in the tympanic cavity, and in such instances cerebral abscess or meningitis may be the immediate cause of death. In the latter case a *post-mortem* examination reveals pus in the arachnoid cavity, or between the roof of the tympanum and the dura mater; in the former case, the seat of the abscess may be either in the cerebrum or cerebellum; this portion of the brain (the cerebellum) being more generally, though not always, the part affected when the mastoid cells are involved as well as the tympanum.

The experience of the past few years has amply demonstrated the success which has attended the operation of trephining in those cases where symptoms point to cerebral abscess rather than to general meningitis. The operation should be done under strictly antiseptic conditions; the point selected should be over the temporo-sphenoidal lobe; and when pus is found after an exploration through this opening the wound should be kept carefully drained.

Fatal terminations of this nature most frequently occur when cleanliness and local treatment of the ear have been neglected. Hence the necessity for such care.

But the fact that even under the most favourable conditions such events are possible, when there is a fistulous opening in the tympanic cavity, should induce caution with insurance offices in accepting the lives of persons with this lesion, at the ordinary premiums. Fatal cases of this kind might seem in practice to be almost divisible into two classes—namely, those in which cerebral symptoms come on soon after the establishment of the perforation; and others where there has been a purulent discharge from the ear (that is, from the tympanum) for many years before the advent of such symptoms. In this latter class must be included those cases in which the temporal bone has become the seat of caries; and it may be stated, subject to no exceptions, that whenever exposed bone can be detected by means of examination with a probe within the cavity of the tympanum, the subjects of this condition are always more or less in a perilous state, and that at any time fatal symptoms may commence with a severe rigor, the earliest of all succeeding symptoms. For this reason, even when exposed bone cannot be absolutely demonstrated in the way mentioned, the existence of bone-granulations where there is a perforation of the tympanic membrane should be regarded as a most serious complication. The same danger, though in a very much less degree, may be said to be present when dead bone can be detected in the mastoid process—in a less degree, because the outer table of the bone is often affected whilst the inner remains healthy. The dead bone then in the former position becomes exfoliated, and the external wound heals. Such are briefly the points of importance in connexion with caries of the temporal bone. How caries of the mastoid process may be obviated by a timely perforation of the mastoid cells, and how the chief part of the temporal bone may when carious be removed and the patient survive, may be seen on reference to a paper entitled 'Disease of the Mastoid Bone,' by the writer of this article, in the *Transactions of the Medical and Chirurgical Society* for 1879.

(*c*) *Malignant Disease.*—In the paper just mentioned is also reported a case of malignant disease of the ear, in which the cavity of the tympanum, having been the seat of suppuration for some time, became affected with epithelial growth, which caused the death of the patient. From all recorded cases of malignant disease of the ear, as well as those which have come under the writer's notice, it would seem that the seat of origin of the new-growth will be found to be the lining membrane of the tympanic cavity, and that a purulent discharge from this surface always precedes the appearance of the cancer, and must therefore be regarded as the exciting cause of the growth. In its early stages cancer in this situation bears a strong resemblance to the ordinary forms of polypus. The same cause, then, which in some cases calls into being a polypus, may occasionally give rise to malignant disease, and this without any predisposing cause (so far as can be ascertained) in the patient towards cancerous growth.

III. Internal Ear.—Apart from deafness due to local changes in the external or middle ear, the function of hearing is subject to impairment from causes which have their seat in the nervous structures of the ear; in other words, although the conduction of sound may be good, the perception of sound may be faulty. The inability to hear the vibrations of sound conveyed through the cranial bones, such as from a vibrating tuning-fork placed upon the vertex, is indicative of this condition. For the rest, the absence of tympanic disease, and the history of the case, must supply the evidence required for a diagnosis. Familiar examples of this nature are the deafness which often accompanies old age, or which is left after fevers when the middle ear has not suffered; the two forms of syphilitic nervous affection to be presently mentioned; the sudden and sometimes total loss of hearing which occasionally follows severe mental shock; the deafness after loud explosions near the ear, so common in artillerymen and naval men; and that which is caused by blows on the head and boxes on the ear. An attack of mumps will sometimes leave behind an irremediable loss of hearing in one or both ears, unattended with any discoverable change in the tympanum. In a similar way weakly women occasionally become more or less deaf during their confinement, and this symptom becomes aggravated as each successive child is born. In connexion with this subject, prolonged suckling may be mentioned as one of the numerous debilitating causes which undoubtedly aggravate the trouble of an already impaired ear.

Among the nervous affections of the auditory apparatus possessing certain characteristics which serve to distinguish it from others is the so-termed Menière's disease, an attack of which at times gives rise to symptoms which would be alarming if their true origin passed unrecognised. A patient who suffers in this way is seized with an attack of vertigo so severe that he not infrequently falls, and for some hours afterwards requires assistance in walking; occasionally vomiting succeeds the giddiness; and he recovers to find himself very deaf in one ear, with which previously he had heard well. Milder attacks of the same nature generally follow the first, and each one leaves the patient more deaf. Although with many writers it is a favourite theory that the seat of morbid changes in this disease is in the semicircular canals, up to the present the point has not been satisfactorily determined. No treatment appears to exercise any influence upon the disease. *See* Vertigo.

Syphilis.—The affections of the ear due to syphilitic disease demand separate consideration. They occur under the following varieties: Firstly, in the form of sores and warts in the external meatus, which yield to local treatment. Secondly, affections of the middle ear during the secondary ulceration of the throat, the treatment for which, beyond specific medicines, in no way differs from what is useful in the ordinary catarrh of the same parts. Thirdly, failure in hearing power during the secondary stages, unattended with any change in the middle ear. This disappears under constitutional remedies. Fourthly, the loss of function in the auditory nerve, so commonly met with in the subjects of inherited syphilis. In these patients the hearing power begins to fail between five and fifteen years of age (very seldom later in life), and proceeds to very great and often total deafness, the period between good hearing and the extreme point of deafness arrived at varying from a few weeks to several years. From this cause children sometimes become in the course of a month or six weeks totally deaf, but such rapidity is exceptional. Experience has shown how powerless treatment is to arrest the progress of this affection, so that attention should be confined to preventing its subjects from becoming dumb, if they are attacked after they have acquired speech, and before they are likely to forget it, namely, from about four to seven years of age. This is best attained by teaching them lip-reading; and if they can read, by making them do so (*aloud*) several times each day. In this way a child will retain its recollection of language when otherwise speech would pass away. W. B. Dalby.

EAUX-BONNES, in France.—Sulphur waters. *See* Mineral Waters.

EAUX-CHAUDES, in France.—Sulphur waters. *See* Mineral Waters.

EBURNATION (*ebur*, ivory).—A state of bone-tissue in which it assumes the whiteness, smoothness, and hardness of ivory, in consequence of an increased deposit of calcareous matter. It occurs chiefly in rheumatic arthritis. *See* Rheumatic Arthritis.

ECBOLICS (ἐκβολή, abortion). — This name is given to the measures which produce abortion, or expulsion of the contents of the uterus. In moderate doses ecbolic drugs may act as emmenagogues. *See* Emmenagogues.

ECCHYMOSIS (ἐκ, out of; and χυμός, juice).—An extravasation of blood into the cellular tissue, due either to injury or to disease. It presents at first a more or less blue or bluish-black appearance, which changes with age, passing through green to yellow. *See* Extravasation.

ECHINOCOCCUS (ἐχῖνος, a hedgehog; and κόκκος, a grain or berry).—*See* Entozoa.

ECLAMPSIA (ἐκλάμπω, I flash, I explode).—This term is now used as a synonym for convulsions, whatever may be their cause. *See* Convulsions.

ECPHYMA (ἐκ, out of; and φῦμα, a swelling).—A growth from the integument. The term was employed by Mason Good as a designation for warts and corns, but is at present almost obsolete.

ECSTASY (ἐξίστημι, I amaze).—Definition.—The term 'ecstasy' has been applied to certain morbid states of the nervous system, in which the attention is occupied exclusively by one idea, and the cerebral control is in part withdrawn from the lower centres and those for certain reflex functions. These latter centres may be in a condition of inertia, or of insubordinate activity, presenting various disordered phenomena, for the most part motor.

Description.—The subjects of ecstatic phenomena are commonly of the female sex, or are men who lead celibate and ascetic lives. To such individuals, they are in the present day almost confined. In the middle ages, on several occasions, under special circumstances, an intense dominant emotion, with some attendant ecstatic manifestations, was known to spread widely by a sort of moral contagion.

Women who are the subjects of this morbid state are usually single, frequently present menstrual irregularities, and often distinct evidences of hysteria, of which the ecstatic condition may be but a part. The immediate cause of the attack is usually some repeated vivid emotion, commonly religious, sometimes one of fear. The direction taken by the motor or other phenomena of the ecstatic state is often very obviously determined by imitation. With this direction there is associated, in some cases, the assertion of supposed facts, which transcend the ordinary course of natural phenomena, and which have been proved, in many instances, to depend on intentional fraud.

As forms of ecstasy we have the condition of some religious enthusiasts, in whose dominant state all other mental processes are merged. Dreams and visions are determined by the ecstatic emotion and add to its intensity. Consciousness of the body may even be lost, so that all sensation is gone for a time; while the corporeal functions, including ingestion and egestion, are reduced to a minimum, and a little exaggeration may represent them as in complete abeyance. Hence the 'fasting girls' that have arisen in various countries, by whom 'stigmata' marks, in the positions of the nails employed in crucifixion, are sometimes presented, probably by artificial production, but possibly by the influence of the mental state on the processes of nutrition in the parts to which attention is directed. In some hystero-epileptics a state of ecstasy—of rapt, intense emotion—forms part of the paroxysmal seizures, and then wild muscular spasms replace the tranquil repose of the more volitional ecstatics. Occasionally—when an intense emotion is shared by many persons—insubordinate muscular movements occur, of a rhythmical character, seen in the Jumpers and Shakers of the present day, and more strikingly in some of the dancing religious ceremonies of half-civilised races, and in the dancing epidemics of the middle ages. Such was the original dance of St. Vitus, in which the exciting emotion was religious; and such also the 'tarantella,' in which the excitant was terror at the supposed consequences of the bite of the tarantula, which the dance was intended to avert. The phenomena now manifested in the epidemics that have been described under the name of the 'Jumpers,' &c., merit, indeed, more detailed notice, since they have been observed in remarkable degree and conspicuous form in certain races in whom the process of brain development concerned in what we term 'civilisation' is taking place—with a slowness that is probably alike typical as regards the past, and instructive as to the process. The conditions especially favourable for the development of these disorders appear to be generated by the close contact of such races with those in whom the process of evolution of the nervous system has been carried farther; and the less developed organisation is, as it were, strained by a connexion which it is not strong enough to endure. At all periods a pathogenic influence has probably also been exerted by the excessive tension placed on some mental faculties by certain religious systems, but the effect is greater when the strain comes from without, and the nervous constitution is warped by the inequality between its own strength and that of the race with which it is not only in contact but attachment. The cerebral functions may be deformed by emotions that would be powerless to disturb a brain whose functions were strengthened by equal development in all parts.

It is especially among the negro tribes in contact with more civilised white races, that the most conspicuous forms of ecstatic disease have been observed. A condition described by Hammond under the term 'Miryachit' (Russian, *Miriatchit* = 'playing the fool') is almost identical with that met with in the so-called Jumpers. The subjects of this condition have been met with chiefly in Siberia; but an exactly similar condition is met with in Java, where it is known as 'Lata' or 'Latak.' Both sexes are liable, but most sufferers are females. It occurs in epidemics, especially involving several members of the same family; although sporadic cases are often met with. Contact with a person who is the subject of this affection is often the exciting cause; but sometimes the malady is distinctly hereditary. Natives and acclimatised immigrants are exclusively attacked, and of them only children and persons of a low intellectual development. The characteristic of the disease is that its subjects are compelled to imitate any sound, gesture, grimace, or act, even if it gives rise to pain, anger, or remonstrance. As a rule the malady is chronic, but presents spontaneous remissions. The general health is unaffected, and the patient is not incapacitated from work. Thus the chief difference between this condition and most other ecstatic states is, that the subjects of Miryachit re-act only and simply to impulses entering through the afferent optic and auditory channels; and when an order is given they do not perform the acts, but simply repeat the words of the order.

The state of 'somnolentia,' or 'sleep-drunkenness,' is closely allied, psychically, to the conditions under discussion, although differing in its associations, by which it is connected more closely with epileptic mania than with the ecstatic disorders. The subjects of this condition perform some act, it may be even of violence or murder, on being suddenly awakened from sleep—the action being often prompted by a dream.

The close resemblance between ecstasy and some forms of hysteria has already been alluded to; but what is of still greater interest is the fact that suggestion plays a most important part in all the conditions that have here been discussed, and that all these conditions seem, as it were, to form links in the chain which connects the dancing epidemics of the middle ages with the phenomena of suggestion and hypnotism of the present day.

A remarkable case is quoted by Hammond, of a gentleman who would perform any act he was told to by a person whispering into his ear while he was asleep.

Treatment.—It is rarely now that ecstatic manifestations have to be treated except as part of pronounced hysteria, and the treatment is that of the hysterical state which underlies the ecstasy. The measures of paramount importance are the substitution of a 'healthy moral atmosphere' for that under which the symptoms have arisen; and the exposure of actual fraud. Occasionally, even now, examples of solitary ecstasy come under observation. In these cases considerable care and tact are needed. Ecstatics are not amenable to the motives which influence most persons, and, if there is actual fraud, will sometimes die rather than be found out. In the case of fasting girls, due observation of the body-weight during a short time will answer as well as, and is much safer than, a long exclusion of food. But the removal of the ecstatic to other surroundings is the most important step for both detection and cure.

W. R. Gowers. J. S. Risien Russell.

ECTHYMA (ἐκθύω, I burst out).—A pustule or pimple; pathologically occupying a mid-place between a pustule and a furuncle. The so-called tar-acne, the small inflammatory pustules developed around a mother-boil, and the commoner eruptions produced by iodine and bromine, are examples of ecthyma. *See* Skin, Diseases of.

ECTOPIA (ἐκ, out of; and τόπος, a place). An abnormal protrusion or displacement of a part; for example, *ectopia vesicæ*, protrusion of the bladder. *See* Organs, Displacement of.

ECTOZOA (ἐκτός, without; and ζῶον, an animal).—A term employed by some naturalists to embrace all the external parasites. *See* Epizoa.

ECTROPION
ECTROPIUM (ἐκ, out of; and τρέπω, I turn).—A condition in which the eyelid becomes everted, so that the conjunctival surface is exposed. *See* Eye and its Appendages, Diseases of.

ECTROTIC (ἐκτιτρώσκω, I miscarry).—A term applied to arrest of the course of a morbid process, for example, the development of small-pox. The agent by which the pustule is made to abort, named the ectrotic, may in this instance be a point of nitrate of silver. A coating of plaster, and especially substances which will exclude the light, such as mercurial ointment, or an ointment of lampblack, are likewise employed as ectrotics of small-pox.

Erasmus Wilson.

ECZEMA (ἐκζέω, I bubble up).—Synon.: Fr. *Eczéma*; Ger. *Eczem.*

Definition.—An inflammatory disease of the skin, which in its typical form is associated with the formation of papules and vesicles which quickly burst, and leave a more or less excoriated surface, discharging a gummy serous fluid, which stiffens into a thin crust as it dries. The disease is always attended with itching.

Ætiology.—Eczema is by far the most common disease of the skin, and is said to constitute about one-third of all the cases of skin-disease. It occurs at all periods of life, from infancy to old age, but is probably rather more common during the first and second dentitions, and in the later period of life, than in youth or middle age; on this point, however, there is some difference of opinion, and in any case, age is not a very constant factor in its development. It is generally admitted to be somewhat more common in males than in females.

The principal causes of eczema may be conveniently divided into three groups: (1) those that are strictly local, such as varicose veins, and the various forms of local irritation; (2) more general causes, such as teething, errors of diet, overwork, and anxieties of all kinds; (3) a constitutional tendency to the disease. It must be admitted, however, that there are cases of eczema for which no definite assignable cause can be found.

With regard to strictly *local* causes, varicose veins are perhaps the most important. Irritants, however, such as tincture of arnica, stimulating plasters and embrocations, often give rise to local attacks of eczema in those who are predisposed to it. Exposure to extreme heat or cold is amongst the well-recognised exciting causes of the malady, which is often a source of annoyance to Europeans living in the tropics. A Turkish bath will sometimes produce a papular eczema such as we also meet with in stokers. The handling of irritating materials, which is incidental to certain trades, occasionally gives rise to local eczema of the hands. Too frequent washing in hard water may be mentioned as a common exciting cause in those predisposed to the disease.

The *general* causes of eczema are of more importance than the local causes, although they are less certain and definite in their action. In children, the process of teething, an injudicious diet, and worms may be mentioned as generally recognised exciting causes of the disease; of these three, injudicious feeding is the most important, and is by no means confined to infancy or childhood. Constipation and a general neglect of the action of the bowels, is another common cause of the perpetuation, if not of the development, of the malady.

With regard to a *constitutional* tendency to the disease, it is, without doubt, common. In some instances, this tendency is so strong that eczema may be said to be always present throughout life, or with but short intervals of freedom. It is generally believed that gouty families and individuals are more liable to eczema than those that have no tendency to gout; the writer does not doubt this fact, but that is very different from the common statement that gout *gives rise to eczema*, for which there is not much foundation.

Symptoms.—Eczema is remarkable for the varying appearance it assumes, according to the acuteness of the inflammation, the stage of the disease, and the parts affected. In an early stage it generally consists of a red and slightly swollen patch; later on, this may be covered with papules and vesicles, which are usually of short duration, to be followed by the development of a moist excoriated surface, discharging a serous or gummy fluid. When the process of healing begins, the patch becomes dry, and covered with thin scaly crusts, which ultimately fall off, and leave the skin in a comparatively healthy condition. Although this is the description of typical eczema, yet the varieties in the course and character of the eruption are so great that they require a brief notice.

There are three principal variations in the development of the eruption: (1) The inflammation may be very acute, and the exudation of serous fluid into the skin and subcutaneous structures so rapid and excessive as to produce great swelling of the tissues. This is especially met with in acute eczema of the face, in which there is sometimes closure of the eyelids, and a complete alteration in the features, so that the patient can be hardly recognised. (2) A very common variation from the normal course of the eruption is the development, from the first, of dry, red, slightly scaly patches, which are never moist, and but little swollen. Eczema of this kind is always attended with much itching, but with no pain or tenderness on pressure. (3) A general eruption of minute red papules over the body and limbs, is another very common form of the disease. The papules usually develop rapidly, and are distributed symmetrically over the body, reminding one, at a little distance, of a scarlatina rash. The eruption generally aborts, dries up, and desquamates without the formation of visible vesicles, though now and then a few may be found amongst the bright red papules.

The various forms or stages of eczema are sometimes indicated by qualifying names; thus the earliest phase consists simply of hyperæmic patches and is called eczema *erythematosum*; later on we may have eczema *papulosum*, and *vesiculosum*; soon the vesicles burst, and leave a raw, discharging, excoriated surface, to which the term *ichorosum* has been applied; when the congestion is great, it is called eczema *rubrum*. The formation of a puriform discharge is indicated by the name *impetiginosum*; and lastly, eczema *squamosum* is applied to the disease in its scaly condition. One or all of these phases of eczema may sometimes be seen in different regions of the body at the same time.

Although the skin of any part of the body is liable to be attacked by eczema, yet it may be said to have a preference for certain regions, as, for example, the flexor surfaces of the limbs, the hands, the scalp, and the points of junction of the skin with the mucous membranes. In some of these regions, such as the hands, the lips, and the anus, local causes play an important part in the perpetuation, if not in the development, of the malady. Eczema is generally distributed symmetrically, though there are many exceptions to the rule. With regard to subjective sensations, it may be said that they are always present, and form one of the most troublesome symptoms of the disease. In most cases itching is a very characteristic feature; the only exception to this rule is met with in acute eczema, in which the sensations of pain, burning, and smarting for a time mask or take the place of itching; but when the inflammation subsides, itching is sure to arise. In no other affection, except prurigo, is itching so constantly present.

Diagnosis.—Eczema is liable to be mistaken for the following diseases: erysipelas, scabies, psoriasis, sycosis, tinea tonsurans, superficial lupus, and some syphilitic eruptions.

Eczema and Erysipelas.—Acute eczema of the face, with much exudation into the subcutaneous tissue, is the only form liable to be mistaken for erysipelas. The following points will aid the differential diagnosis: (1) In erysipelas, the eruption is preceded by rigors. (2) The pulse, temperature, and febrile symptoms generally are higher than in eczema. (3) There is almost always headache, and often albuminuria. (4) Erysipelas has a more sharply defined margin, and a smoother and more glazed surface. (5) Erysipelas commonly begins round or below one orbit, and is, more often than eczema, unilateral at first, although, in the end, both sides may be affected.

Eczema and Scabies.—These two diseases are often confounded, for the very obvious reason that scabies leads to a kind of artificial eczema. Apart from the use of the microscope, which cannot always be applied, the following considerations will aid the differential diagnosis. Scabies especially attacks certain regions, and when a pimply eruption is met with between the fingers, and on the flexor surface of the wrists, and also at the same time on the lower part of the abdomen, penis, and nates, a very careful examination should be made for other signs of scabies. An examination over the wrist with a common magnifying-glass will often lead to the detection of the scabies cuniculus, looking very like a pin-scratch. The history of the case will also aid the diagnosis.

Eczema and Psoriasis.—Dry scaly forms of eczema may be mistaken for psoriasis, though the more sharply defined and raised margin of the latter, with a tendency to form rings, usually makes the diagnosis easy. The development of the eruption on the points of the elbows and just below the knee-caps, is very distinctive of psoriasis.

Eczema and Sycosis.—The very chronic character of sycosis, and the absence of any running exudation, together with its strict limitation to the hairy parts of the face, will generally serve to distinguish it from eczema. In a recent attack the differential diagnosis is difficult, but not of much importance, as the two diseases are very closely allied.

Eczema and Tinea Tonsurans.—It is only ringworm of the body that can be mistaken for eczema. A solitary patch of dry eczema-like eruption, spreading at the margin, at once suggests the probability of ringworm. The diagnosis will be rendered almost certain if a narrow margin of the round patch is sharply defined, slightly raised, and of a brighter colour than the other parts. If no treatment has been adopted, the microscope will complete the diagnosis; but if any active remedies have been applied, the microscopic examination is useless.

Eczema and Lupus.—Patches of superficial lupus sometimes become covered with scales and eczema-like crusts, which mask the real nature of the disease. A careful examination will, in any doubtful case, lead to a correct diagnosis.

Eczema and Dermato-syphilis.—Pustular syphilitic eruption of the scalp may be mistaken for impetiginous eczema. The presence of superficial ulceration, and a peculiar offensive smell, are characteristic of the syphilitic eruption, apart from other signs of syphilis. Dry, cracked eczema of the palm is very common, and is sometimes confounded with a similar condition which is due to syphilis, and often miscalled 'psoriasis palmaris.' This kind of eczema is generally attended with much itching, which is not the case with the syphilitic eruption. Eczema is, moreover, rarely confined to one palm, while the syphilitic eruption is often unilateral. The history of the case will also aid the diagnosis.

Treatment.—The variations in the character of eczema are so great that it is impossible to lay down rules of treatment that will meet all cases. Some general directions may, however, be given, which will serve as guides, though nothing can supply the place of practical experience.

Acute Eczema.—The treatment of acute eczema is simple. In all very severe cases the patient must be confined to bed or the couch. Moderate or free purging with sulphate of magnesium or sulphate of sodium is always indicated, some care being of course required in the case of weakly or elderly people. When the attack is of gouty origin, the purgative treatment may be supplemented by the use of alkalis with iodide of potassium or colchicum, according to circumstances. In the local treatment of acute eczema, all ointments of a stimulating kind should be strictly avoided. If the inflammation is confined to the limbs, water-dressing or a weak lead lotion is often the best application, but it must never be allowed to get dry. During the day, when the dressing can easily be kept moist, it is better not to cover it with gutta-percha tissue; but at night this plan may be adopted, in order to prevent the lint from getting quite dry. It is difficult to apply water dressing to the head and face, and under these circumstances fuller's earth or starch and zinc powder is a useful application. If, however, this does not suit, the linimentum calcis, made with sweet almond oil, may be used; it should be either applied on lint or simply painted on several times daily. Some patients derive great benefit from thin linseed meal poultices, which do not require changing so often as water-dressings, otherwise the principle of treatment is the same in both.

Sub-acute or Chronic Eczema.—The *general treatment* of sub-acute or chronic eczema will depend more on the character of the eruption, and the age of the patient, than on the parts affected; the *local treatment*, on the other hand, must be modified to suit the regions attacked. The general treatment would include rest, change of air, diet, and medicine, according to the severity of the case, and other attendant circumstances. If the patient is suffering from gouty symptoms, dyspepsia, or constipation, the plan of treatment should be adapted to meet these conditions, with a considerable probability that it will also be the most suitable treatment for the eczema, which may of course be dealt with at the same time by local means. When, however, the patient is young and in good health, arsenic in moderate doses will be found the most generally useful remedy. In children between the ages of two and five, one-drop doses of the liquor arsenicalis given after meals three times daily is usually enough; it may be combined with alkalis or laxatives or tonics according to circumstances. The routine practice of treating ordinary eczema in young children with iron and cod-liver oil generally ends in failure, especially when the eczema is of an irritable kind. In the pustular forms of eczema, however, iron is useful, and then the arsenic may be combined with the vinum ferri or some other preparation of iron. In people of middle age, arsenic is not so generally useful as in children. In the sub-acute irritable forms of eczema, vinum antimoniale in small doses, with diuretics, may often be given with advantage instead of arsenic.

In all forms of eczema the greatest attention should be paid to the action of the bowels. The malady is often associated with constipation, and even when this is not the case, some increase in the natural action of the bowels is highly beneficial. The kind of purgative to be used will depend on the age of the patient and other circumstances. In infancy, fluid magnesia in milk is one of the best; in childhood, sulphur powders or lozenges, or mild saline purgatives, are most suitable; for adults, sulphate of magnesium or sulphate of sodium, given either before breakfast in full doses, or in smaller doses with some tonic two or three times daily, is suitable; lastly, in old age, mild aloetic pills may be given.

The use of Tar in Eczema.—For many forms of chronic dry eczema, the various preparations of tar are among the most useful local remedies. They do more to relieve the intolerable itching than any other class of remedies, the chief drawbacks being their disagreeable colour and smell. Before applying tar preparations to eczema, it is always advisable to try the effect in a much diluted form, or over a very limited area; for when applied to unsuitable cases they sometimes produce a great aggravation of the disease. The ordinary tar ointment may be freely diluted with any other ointment, such as zinc ointment, and subsequently the quantity of tar increased or diminished according to circumstances. The tar lotions are less disagreeable than tar ointment; they are made by combining the liquor carbonis detergens (made from coal tar), or the liquor picis compositus (made from vegetable tar) with water, or some simple lotion, such as the ordinary lead lotion. One to four per cent. of the tar solution is usually enough.

Local forms of Eczema.—*Eczema of the Scalp.*—Special local treatment is sometimes required when eczema attacks certain regions of the body. On the scalp, when it is attended with much discharge, the hair should be cut and kept quite short. All the scabs should be softened by a poultice, and then removed by bathing with warm water. The head should then be carefully dried, and dressed with an ointment consisting of acetate of lead gr. xv, zinc ointment ʒij, calomel gr. xx, nitrate of mercury ointment gr. xx, vaseline ʒij, benzoated lard ℥ss. When the inflammation has subsided, the white precipitate ointment, diluted with an equal quantity of vaseline, may be used. In dry, scurfy eczema of the scalp, the best salve is the red oxide of mercury ointment ʒij, white vaseline ʒvj; this should be applied in small quantities every day. Sometimes when there is much active inflammation, a lotion may be used instead of an ointment until the inflammation has subsided. The most useful are weak sulphate of zinc or boric acid lotions, or carbolic-acid lotion of strength of about one part in a hundred parts of distilled water. Whenever a lotion is used it should never be allowed to get dry; the dressing may be conveniently kept in its place by a light thread or cotton nightcap.

Eczema of the hairy parts of the face should be treated very much like eczema of the scalp. If, however, there is pus-formation in the hair-follicles, it is best to remove the hairs that pass through pustules, and allow the pus to escape; then to wash with weak, strained gruel, and after carefully drying the skin to apply a lotion of calamine and oxide of zinc, so as to dry up the discharge as quickly as possible. The crusts which form, if firmly attached, should be allowed to remain, but when loose from exudation underneath, they should be removed, and, the hair being carefully cut, the surface should then be dabbed with a little medicated wool, and the lotion again applied.

Eczema of the Anus.—This is a most troublesome malady, the itching being often out of all proportion to the amount of visible eruption; when this is the case, it is commonly called *pruritus ani.* The most important point in the local treatment of eczema in this region, is always to wash *directly* after the bowels have acted, *without the use of paper.* For this purpose a jug and basin and a very soft old towel should always be kept in the water-closet. After washing, the eczema should be very carefully dried, and some suitable ointment immediately applied. Among the best are the calomel, the diluted oxide of mercury, and the calamine ointments; a very small quantity of the creasote ointment may be advantageously combined with any of these whenever pruritus is the chief feature of the disease. An occasional painting with a solution of nitrate of silver (gr. x ad ℥j) is very useful. Although it is essential to wash directly after the bowels have acted, yet this should not generally be repeated until the bowels act again, too frequent washing being bad for the eczema. A little cotton-wool placed so as to keep the skin on the two sides from touching is very useful.

Eczema of the Auditory Meatus.—Any accumulation of crusts should be first removed by syringing with warm water; this should be followed by the use of a tepid sulphate of zinc lotion (gr. iij–vj ad ℥j) several times daily; an occasional painting with a solution of nitrate of silver (gr. viij ad ℥j) is often useful. When the eczema is of the dry kind, citrine ointment diluted with six parts of oil or vaseline, and applied to the inside of the ear carefully with a camel's-hair brush, is the best remedy.

Fissures in Eczema.—Fissures are apt to occur in eczema at the corners of the mouth, between the toes, about the anus, and along the lines of flexure in the palm of the hand. The best treatment for these is to carefully paint a solution of nitrate of silver (gr. xv ad ℥j) into the *bottom of the crack*, with a very fine camel's-hair brush, once a day.

Eczema of the Nipple is often difficult to cure. It should be *protected from touching the clothes by a shield*, and painted daily with a solution of nitrate of silver (gr. x ad ℥j).

Chronic Eczema of the Palm is a most obstinate malady. This arises from the natural thickness of the cuticle, which does not readily allow the escape of exudation, but cracks and leaves troublesome fissures, especially at the lines of flexure. Moreover, the hands are constantly exposed to the unfavourable conditions of movement and frequent washing. In these cases, if the outer cuticle is much hardened and thickened, it is necessary to remove it. This may be done either by macerating it with a weak lotion of liquor potassæ and distilled water (ʒij ad ℥viij) applied on lint, or by painting it for a few days with a saturated solution of salicylic acid in flexible collodion. When the hard cuticle is removed, the hand should be dressed with the oleate of zinc, or some other soothing ointment. Gloves should be constantly worn, so as to avoid the necessity of washing until the hand is quite well.

Eczema of the Leg.—The special indication in the treatment of eczema of the leg is careful bandaging from the foot up to the knee. In some few cases the solid india-rubber bandages are most useful, but they are not always easily borne.

Pruriginous Eczema.—Some forms of dry eczema affecting large areas of the body are attended with such intense itching that the patient loses all power to resist the temptation to scratch. As a consequence the skin is torn and lacerated with the nails of the sufferer, which only gives temporary relief. Under these circumstances Professor Unna recommends a kind of gelatine paint made by combining zinc oxide and gelatine, each one part, and glycerine and water each four parts. This is melted when required by placing the jar in hot water, and then painted on with a soft shaving brush. The remedy is rather a disagreeable one, but sometimes useful to prevent scratching in severe cases.

Diet.—A careful diet is of considerable importance in the treatment of eczema, especially in children, and in gouty or dyspeptic people. Children suffering from *pustular* eczema require a liberal diet, and especially a little beer or wine, and plenty of fresh meat and vegetables. Even infants with pustular eruptions often require alcohol in small quantities, the best form being from 15 to 20 drops of French brandy in milk two or three times daily according to circumstances. It is the formation of pus which appears to indicate the use of small doses of alcohol. On the other hand, dry irritable eczema in adults is often benefited by a reduction in the usual amount of alcohol. Some kinds of food, such as highly salted meat and fish, sweets—including dried fruits, coffee, and oatmeal, appear to be unsuitable for most kinds of eczema.

Washing in Eczema.—Perhaps there is no more common mistake in the treatment of eczema than too frequent washing; indeed, the mistake is a very natural one. In all ordinary cases of eczema, *washing with soap and water must be forbidden*; and this is most essential when the eczema is healing, and the new, delicate cuticle is forming, for then water macerates and destroys it, and thus the duration of the disease is needlessly prolonged. As a matter of fact, starch or fuller's earth powder keeps the skin quite clean, and also favours the healing process. If washing is absolutely necessary, as it is sometimes in an early stage of the disease where there is much discharge, weak, strained gruel, made with soft or distilled water, is always preferable to soap and water, but even that should not be used often.

Baths in Eczema.—It is difficult to lay down any definite rule with regard to the use of baths in eczema. In some forms of eczema, especially in young children, baths do much harm. In gouty people, on the other hand, who suffer from dry chronic eczema resembling psoriasis, a course of mild alkaline baths is often very beneficial. Great discrimination, however, is required in the choice of baths. The summer is the most suitable time of the year for the bath treatment. Robert Liveing.

ECZEMA MARGINATUM. — *See* Tinea trichophytina; and Erythrasma.

EFFUSION (*e*, out; and *fundo*, I pour). The escape of a fluid from its natural channel or cavity into the substance of organs or the cellular tissue, or from free surfaces. As examples may be mentioned dropsy in its various forms, and effusions resulting from inflammation.

EGYPT, UPPER.—A very dry, tonic, winter climate. Mean winter temperature, 62° F. Season, October to March. *See* Climate, Treatment of Disease by.

ELECTRICITY IN MEDICINE.— The purposes for which electricity is employed in medicine are various. It is used as a stimulant to excite muscular and nervous tissue which is the seat of paralysis or pain, and as a stimulant to the tissues generally; its chemical action may be employed for dissolving tissues and coagulating blood within aneurysmal sacs; and its thermal effects are employed in surgery for heating cauteries. The incandescent electric light has been adapted for the illumination of the throat, as well as of the bladder and other cavities of the body. Electricity is used in its three forms of—(1) *Franklinic*, *static*, or *frictional* electricity; (2) *Faradism*, *i.e.* electricity generated by induction, whether voltaic or magnetic; and (3) *Galvanism* or *Voltaism*, which owes its existence to chemical action.

Apparatus. — 1. *Franklinic electricity*, which is generated by the friction of glass discs or cylinders, and which was formerly much in vogue, may again possibly take its place as a recognised therapeutic agent. Charcot contends that in some cases of muscular wasting, franklinism will produce a contraction where both faradism and galvanism fail to do so; and in some cases of 'hysteria' also franklinism seems to be of undoubted service.

2. *Faradic batteries* should consist of (*a*) a coil of insulated copper wire, the ends of which are in connexion with the plates of a galvanic cell. This is called the *primary coil*, and contains a bundle of soft iron wire in its interior. (*b*) A second coil of insulated copper wire, made of finer wire, and containing a greater number of spirals than the primary, over which it is made to slide; this is called the *secondary coil.* (*c*) An *interrupter*, capable of interrupting the current automatically and with great rapidity, by means of the constantly recurring magnetic action of the bundle of iron wires in the interior of the primary coil. These batteries should have means of graduating the intensity of the current of either coil, and of including the patient in the circuit of either coil without altering the connexions of the conducting wires. Sometimes the galvanic element is replaced by a large magnet, as in the well-known rotating magneto-induction apparatus.

3. *Galvanic batteries*, when used for therapeutic or electrolytic purposes, should be composed of (*a*) a large number of small cells of low electromotive force, and as constant in their action as possible. The cells known as the 'Leclanché' are the best. (*b*) Means of including in the circuit any number of cells at will, so that thereby the intensity of the current may be regulated. (*c*) Means of opening or closing the circuit at will, and of reversing the direction of the current without altering the position of the current-carriers (rheophores) on the patient's body. This is effected by means of a simple contrivance known as a *key and commutator.* (*d*) A galvanometer. Practitioners who only make occasional use of electricity should select batteries of the simplest construction; and for rough therapeutic purposes a box of cells provided with screw terminals (one terminal for every third or fourth cell) is all that is necessary. Accessories, such as interrupters, reversers, and galvanometers, should, if needed, be purchased independently and connected with the battery when required. The galvanometer is, for the purposes of exact diagnosis, for physiological experiment, and for electrolytic operations, quite indispensable, as by its use alone are we able to say what strength of current is operating. Not only does the electromotive force of the cells employed vary momentarily, but the resistance of the body varies in the same and in different individuals, so that to say that a current from 'so many cells' has been used is no guide. The galvanometer alone is able to measure the intensity of the current em-

ployed, and these instruments are calibrated to register intensity in milliampères; and in recording we say that 'the muscle contracted with a current of so many milliampères,' &c.

Batteries which are required for heating wires and cauteries must be composed of cells of high electromotive force, and as large as is practically possible. The number of cells or elements is of less importance than their size. It is not unusual to have, for this purpose, Groves's or Bunsen's cells capable of containing a pint of liquid each. Accumulators or storage batteries are now much used for this purpose.

The essential and distinctive differences of the two forms of current (galvanic and faradic) will now be described.

The Galvanic Current.—The galvanic current is (1) *continuously evolved*; hence it is spoken of frequently as the 'continuous current;' (2) It *flows always in the same direction—i.e. from* the positive pole, which is in connexion with the copper or receiving plate, *to* the negative pole, which is in connexion with the zinc or generating plate. This fact must be constantly borne in mind, because the action of the two poles is markedly different, and it has been asserted (on very doubtful evidence, however) that the direction of the current in the body, whether towards the nerve-centres or towards the periphery, has an important effect upon the physiological and therapeutical results. (3) It has well-marked *chemical and thermal effects.* This action is most marked at the negative pole, with which, if a moderately intense current be used, heat, redness, inflammation, and even sloughing of the skin may be readily produced. It is therefore always necessary to frequently change the position of the negative pole on the body. (4) It has *electrolytic* effects. When a galvanic current is passed through a conducting compound liquid, decomposition of the liquid results, oxygen (if water only be used) and acids (if saline solutions be used) being evolved at the positive pole, while hydrogen or alkalis, as the case may be, are evolved at the negative pole. Since the human body consists of a mass of cells which contain and are bathed in saline fluids, many of the phenomena observed on passing galvanic currents through the human body, or any part of it, are probably due to this electrolytic action. Faraday called the positive pole the *anode*, and the negative pole the *cathode*, and these terms are frequently employed.

Induced Current.—With regard to the induced current, the following points must be remembered. (1) It is *momentary* in *duration.* (2) Its *direction is constantly changing*, so that, in using it, it is less necessary to distinguish between the poles. (3) Its *chemical, thermal, and electrolytic effects* are *nil.* (4) It has much greater '*tension*' than the galvanic current—that is, it overcomes the resistance of the body with far greater ease. (5) It *causes the contraction of healthy muscle* far more readily than the galvanic current. Muscular contractions only occur at the moment of making or breaking a current, and it is mainly to the rapid interruptions of the induced current that its high stimulating power is due. The current of the secondary coil has greater tension, more penetrating power, and greater stimulating power than the current of the primary coil or 'extra-current.' This is due to its being composed of finer wire, and having a greater number of turns.

The stimulating effects of the galvanic current which cause muscular contraction occur only at the moment of making or breaking the current, and not during its continuance, and the stimulating effect of the two poles is different, as may be demonstrated by the 'polar method of investigation,' instituted by Brenner of St. Petersburg. If one rheophore be placed on an indifferent part of the body, as the back, and the other be placed over a nerve-trunk or muscle, we are able by means of the commutator and key to study the action of either pole on nerves and muscles during the making and breaking of the current. With weak currents it is found that contraction ensues only when the stimulating rheophore is negative (cathode), and only on closing the circuit. This is called Cathodal Closure Contraction (C.C.C.) If the strength of the current be slightly increased, we get contraction also when the stimulating rheophore is positive (anode), and the circuit is opened (A.O.C.) Next follows Anodal Closure Contraction (A.C.C.), but Cathodal Opening Contractions (C.O.C.) never occur in healthy muscles with any currents short of those of unbearable intensity.

The galvanic current, unlike the induced current, affects the nerves of special sense. If it be applied in the neighbourhood of the eyes, flashes of light are seen, and blindness has resulted in one case from the incautious application of strong currents to the face. The gustatory nerve is affected in a similar way, and the 'galvanic taste' is perceived when the rheophores are placed on the cheek. The taste is acid with the positive, but metallic and coppery with the negative pole. If the rheophores are held to the ear, rumbling noises are produced, and it is said that stimulation of the olfactory nerve will give rise to a peculiar smell.

Onimus has pointed out a further distinction between the induced and the galvanic current. 'An induced current,' he says, 'only acts during the infinitely short time of its passage, after which everything returns to order. . . . It can never be anything else but a series of slight excitements. With constant currents real excitement is determined only at the times of making and breaking.

. . . It is during the silent period, however, that the principal action of the continuous current makes itself felt.'

It is certain that the rapid interruptions of the induced current, and the strong muscular contractions caused thereby, are capable, if the current be moderately strong, of rapidly and completely exhausting the irritability of a muscle, and, if this fact be not constantly borne in mind, harm instead of good will result from the application of faradism. The galvanic current, on the contrary, possesses remarkable refreshing effects, a fact which has been demonstrated by Heidenhain on frogs, and by the writer on the human subject. It is found that a man can sustain a weight at arm's length far longer than he otherwise could, if a galvanic current be passed through the nerves of the limb. The feeling of fatigue can be removed by the application of the current, and the force of muscular contraction is increased thereby. These facts have important therapeutic bearings.

MODES OF APPLICATION.—To apply electricity we need to have conducting wires and rheophores or current-carriers attached to the battery. The best conductors are made of ordinary telegraph wire, which should be as thick as is compatible with pliability. Telegraph wire is not damaged by moisture, and can be readily connected to all forms of batteries and rheophores, and is therefore economical as well as convenient. Rheophores vary much in design. They should all have insulating handles, and the junction between the conductor and rheophore should be about the middle of its length, so that both conductors may be held in one hand without risk of the metallic junctions coming in contact. The most generally useful rheophore is the sponge-holder. An excellent sponge-holder, which retains the sponge with absolute firmness, is that designed by Kidder of New York. Rheophores should be of different sizes, from a sponge as big as half-a-crown to the pointed extremity of an olive-shaped conductor. They should be made of metal and not carbon, because the latter is too brittle. They may be obtained in the form of discs, balls, points; and of endless design for reaching particular organs and regions, as the eye, ear, larynx, bladder, rectum, and uterus. They are usually covered with wash-leather, and used moist. A wire brush is useful for influencing the skin. The dry hand of the operator, who allows the current to pass through his own body to that of the patient, may be used for the same purpose. It is often convenient to fix one rheophore to the patient's body, which may be accomplished by placing an ordinary sponge on the surface of the body, laying thereupon the naked end of the conducting wire, and securing the whole with one turn of a bandage. If we wish to influence the surface only, we may use one rheophore dry; but if we wish to affect deeper-lying structures, we must overcome the resistance of the epidermis by thoroughly moistening it with hot salt-and-water. We may use one rheophore dry, and one moist; or we may use as a rheophore a porcelain or gutta-percha vessel containing water, into which the limb is placed.

There are two methods of applying electricity, known as *general electrisation* and *localised electrisation*. By the former method we pass the current through the entire body or great part of it; it has been employed for many diseases, but its utility is doubtful. By the latter method, which we owe to Duchenne, we seek to influence special nerves, muscles, or organs, and to limit the action of the current strictly to these parts. If we wish to influence a muscle, we may do so either by applying the rheophores directly over the fibres of a muscle, both the rheophores being held in one hand and 'promenaded' over the whole surface of the muscle. This is the *direct* method, and is the method advocated by Duchenne. Or, instead of trying to influence the muscle itself, we may stimulate the nerve supplying it, and so cause the muscle to contract. This is the *indirect* method, advocated by Ziemssen. It is effected by using two rheophores of different sizes. A large rheophore is affixed to an indifferent part of the body, while with a small pointed rheophore an endeavour is made to touch the exact point where the nerve we seek to influence is most superficial. Neither of these methods is to be exclusively adhered to. Certain deep-lying muscles, such as the diaphragm and the supinator brevis, are only capable of indirect stimulation. It will be found also that, in certain diseased conditions, muscles will not respond to stimulation through the nerves, but only to the direct application of the current. When we wish to use the refreshing effects of the current, as in cases of paralysis which are on the road to recovery, or in cases of fatigued muscles, &c., it is advisable to combine the application of the galvanic current with a rhythmical exercise of the affected muscles. Benedict lays it down as a rule that the *locus morbi*, be it brain, spinal cord, nerve, or muscle, should always be included between the rheophores.

DIAGNOSTIC AND THERAPEUTICAL USES.—**1. Diagnostic Uses of Electricity.**—For purposes of diagnosis, electricity is of undoubted service, since by its means we are often enabled to distinguish between paralysis due to central lesion and paralysis due to peripheral lesion. We are accustomed to speak of a paralysis as 'central' so long as that portion of a nerve-centre is sound from which the nerves supplying the paralysed muscles take origin. Thus in cases of damage to one internal capsule, the spinal cord and the greater part of the brain being healthy, we speak of the case as one of central paralysis. In cases, too, of paraplegia from local injury, the cord below the injury being healthy (notwithstanding that all mental control is cut off), we speak of the paralysis as central. In such cases of central paralysis we find (*a*) that reflex stimulation of the muscles is possible, (*b*) that the muscles undergo but little wasting, and (*c*) that the irritability of the muscles to faradism is scarcely diminished. We speak of paralysis as due to a 'peripheral' lesion whenever the paralysed muscles are cut off from communication with their nerve-centres, or directly communicate with centres whose physiological activity has been destroyed by disease. In such cases we find (*a*) that reflex stimulation of the paralysed muscles is no longer possible, (*b*) that the paralysed muscles waste with remarkable rapidity, and (*c*) that the irritability of the muscles to faradism is rapidly diminished, and, as a rule, is ultimately destroyed. To establish the fact of diminished irritability to faradism is generally not difficult, and in cases of paralysis affecting one side of the body only it is done by comparing the paralysed muscles with their healthy fellows. We must take care that the current does not vary in intensity, and that it passes through exactly similar lengths of the body for the stimulation of both sets of muscles. It will be found convenient to fasten one rheophore to the middle line of the body (a big sponge tied to the back of the neck answers well), and then, when the patient's limbs are arranged exactly symmetrically, test the healthy muscles first with a small or pointed rheophore, and determine the current of least intensity which will cause contraction. Then the rheophore is to be applied to exactly the same spot on the opposite limb, and, if contraction follows as readily as on the healthy side, we know that there is no diminution of irritability. If, however, contraction do not follow, we increase the strength of current, and so determine to what extent the irritability is diminished, and whether or no it is completely extinguished. We should add that in cases of peripheral paralysis the diminution and extinction of irritability do not supervene immediately on the occurrence of the paralysing lesion, but only after the lapse of a week or ten days. In paraplegia or other morbid conditions in which paralysis affects both sides of the body it is, of course, impossible to compare a paralysed muscle with its healthy fellow, and in such cases we can only judge of the amount of irritability by experience and mental comparison with previous instances. It is found, in cases of peripheral paralysis, that after complete extinction of faradic irritability the muscles will respond to a slowly interrupted galvanic current, and that not infrequently the irritability of the muscles to galvanism is greater on the paralysed than on the sound side of the body. It sometimes happens that not merely quantitative but qualitative changes take place in the irritability of these muscles, and that the Anodal Closure Contraction (A.C.C.) soon becomes very marked, and equals or even surpasses in force the Cathodal Closure Contraction (C.C.C.); and further that the Cathodal Opening Contraction soon becomes more marked than the Anodal Opening Contraction. These reactions, which are supposed to depend upon degenerative changes in the muscle and motor nerve-endings, have been spoken of as the *degenerative reactions.* These quantitative and qualitative changes in irritability are found (1) in some forms of paraplegia due to degenerative changes in the cord; (2) in so-called spinal paralysis both of infants and adults; (3) in traumatic paralysis due to injury of the nerve-trunks; (4) in rheumatic paralysis, that is, paralysis due to 'rheumatic' thickenings of the neurilemma; and (5) in lead-paralysis.

Its occurrence is probably determined by the degeneration of the motor nerve. In one form of 'rheumatic' paralysis—paralysis of the musculo-spinal nerve from cold, as described by Duchenne—the reactions of the paralysed muscle remain normal.

In ordinary hemiplegia the irritability of the muscles remains, as a rule, unchanged. In some cases, however, the irritability is increased in the early stages; and occasionally after the paralysis has lasted some time we find slight diminution of irritability. In some of the conditions confusedly known as progressive muscular atrophy, the irritability of the wasted muscles to faradism remains undiminished to the end.

2. Therapeutical Uses of Electricity.

a. In Paralysis.—The treatment of paralysis by means of electricity must be conducted rationally and with discrimination. By means of electricity we may attempt to remove the cause of the paralysis, by influencing the nutrition of the parts where such cause is situated, by acting on the sympathetic nerve-branches supplying the walls of the blood-vessels. Thus it is asserted that the absorption of a clot in the brain may be hastened, and that the nutrition of a damaged brain may be improved, by acting upon the cervical sympathetic nerve. To influence the cervical sympathetic we place one rheophore over the superior cervical ganglion (which may be reached by pressing inwards behind the angle of the jaw), and the other on the back, over the first and second cervical vertebræ. The use of such a proceeding is more than doubtful, and in case of any improvement occurring it would be impossible to know to what such improvement ought to be attributed, since the passage of a current across the upper part of the neck must influence many important nerves besides the sympathetic. On the whole, we think that galvanisation of the sympathetic is not to be advised in the early stages of paralysis. Galvanisation of the sympathetic has been employed in chronic degenerative changes in the brain or cord, but with very doubtful success.

The localised application of the electric current to the paralysed muscles is of undoubted service, and in employing it we should bear in mind the following rules. 1. As to the object of our treatment, we should remember the words of Sir Thomas Watson, 'That our aim is to preserve the muscular part of the locomotive apparatus in a state of health and readiness, until peradventure that portion of the brain from which volition proceeds having recovered its function, or the road by which its messages travel having been repaired, the influence of the will shall again reach and reanimate the palsied limbs.' 2. Always to employ that form of current to which the muscles most readily respond. Thus if the muscles act readily to faradism, then faradism is to be used. In some cases of peripheral palsy we find that contraction follows only on the application of a very strong galvanic current, very slowly interrupted, and accordingly a slowly interrupted galvanic current must be used. As the case improves we shall find that a weaker current produces similar results, and that the muscle contracts with moderately rapid interruptions. And so will improvement gradually take place in favourable cases till faradic irritability and lastly voluntary power are restored. 3. Always to employ the weakest currents which will cause muscular contraction, and never to run the risk of exhausting a muscle by causing a too prolonged contraction. Each muscle should be taken in turn, and be made to contract two or three times in succession, and having gone over the whole of the paralysed muscles seriatim the process may be repeated. An application of this kind every other day is usually sufficient. 4. If the paralysis to the will remain absolute, and if the contractility of the muscles be perfect, we do no good by persevering with electrical treatment. This condition is often met with in hemiplegia. The patient is absolutely helpless on one side, although the paralysed muscles are in no degree wasted, and their irritability remains normal. 5. If the paralysis to the will remain absolute, and if the irritability of the muscles be diminished, then electricity is useful, in so far as it helps to improve the nutrition of the muscles and restore their normal degree of irritability. The normal degree of irritability and nutrition being restored (the paralysis to the will remaining absolute) electrical treatment may be discontinued. 6. If the irritability to both forms of current has completely disappeared, we are not justified in persevering too long, nor in holding out delusive hopes to the patient. Nevertheless, treatment should not be abandoned without a patient trial. [For the treatment of special forms of paralysis by electricity, the reader is referred to the appropriate sections of this work.]

β. *In Painful Affections.*—The power of electricity to relieve pain is very great. The relief is usually temporary, but in many cases is permanent. Electricity may act by serving to divert the mind from troubles real or fancied, or its counter-irritating effects may serve the same purpose as other counter-irritants whose power to relieve pain is well recognised. Occasionally electricity will give relief when every known remedy has failed, and in such cases we must suppose that it acts by bringing about some change in the nerves themselves by its specific action on nervous tissue. All three forms of electricity are employed for the relief of pain, but the galvanic current will be found the most generally applicable. Some writers insist that the anode (positive pole) shall be applied to the painful spot. Strong faradisation serves in some cases to give relief. The effects of galvanism should be tried in every case of neuralgia, but it is not capable of relieving all cases, and disappointment is not infrequent. Where muscular movements increase the neuralgic pains, a rhythmical exercise of the affected muscles should be conjoined with the galvanism. Headache of all kinds not infrequently yields to electricity; lumbago, sciatica, and those painful muscular conditions which we call 'rheumatic,' are quickly relieved by it. Tinnitus aurium will sometimes yield to the galvanic current when all other remedies have failed.

γ. *In Spasmodic Diseases.*—In the treatment of spasmodic diseases, electricity is of limited utility. Some forms of tremor are relieved by it. Some aggravated cases of writer's cramp have yielded to it when all other remedies have failed, and a few cases of clonic torticollis have received undoubted benefit by its judicious application. Tonic spasm of internal organs, such as the bowel and bladder, has been relieved by the galvanic current.

δ. *In other Diseases.*—In addition to the treatment of diseases of a purely nervous character, electricity has been employed as a remedial agent in diseases whose origin is not so obviously connected with the nervous system. It has relieved the paroxysms of angina pectoris, and the burning pains which accompany herpes zoster. It has been employed in the treatment of many obstinate skin-diseases by American physicians, and Dr. Cheadle has recorded a case in which the dilated vessels in acne rosacea were made to contract by faradisation. Rheumatic gout is said to have been benefited by a 'central' application of galvanism (one pole to the nucha, and the other to the epigastrium). The flow of urine in diabetes has been stated to be diminished by a similar process; and the symptoms of exophthalmic goître have (it is said) been diminished by galvanisation of the cervical sympathetic. There is in fact scarcely a disease, from epilepsy to chilblains, in which it has not been alleged that electricity has been of use. In obstetric medicine, for the arrest of *post-partum* hæmorrhage, faradisation is now one of the recognised means to be employed; and it has been of more doubtful service for the rectification of displacements of the uterus. Ovarian pain and tenderness have been relieved by the galvanic current, and amenorrhœa has often yielded to electricity.

ε. Galvano-cautery and Galvano-puncture. The chemical and thermal effects of galvanism are largely employed both in surgery and medicine. Its thermal effect has been used for the heating of cauteries; and cauteries so heated have very obvious advantages over all other forms. The chemical effect of the negative pole has been used as a caustic for the destruction of tissues, and tumours of considerable size have, it is said, been 'dispersed' by this means. The treatment of uterine fibroids, as recommended by Apostoli, by passing a current of 250 or more milliampères by means of a big clay rheophore applied to the abdomen and a special platinum rheophore inserted in the uterus, is a mode of treatment which is occupying the attention of obstetricians, and is still *sub judice.* The same may be said of similar measures applied to cancerous and other tumours. Galvano-puncture has been used in the treatment of hydatid cysts of the liver, but it is at least doubtful whether simple puncture is not quite as serviceable. Galvano-puncture seemed at one time likely to take a recognised position among the means at our disposal for the treatment of aortic aneurysms. Several cases were recorded in which improvement followed this method of treatment, but the success attending it has not on the whole been encouraging, and it has fallen almost entirely into disuse. G. V. Poore.

ELEPHANTIASIS ARABUM (ἐλέφας, an elephant).—Synon.: Fr. *Eléphantiasis*; Ger. *Elephantiasis.*

Definition.—A non-contagious disease, characterised by recurrence of febrile paroxysms, attended by inflammation and progressive hypertrophy of the integument and areolar tissue, chiefly of the extremities and genital organs; and occasionally by swelling of the lymphatic glands, enlargement and dilatation of the lymphatics, and in some cases by the co-existence of chyluria, and the presence in the blood of certain nematode hæmatozoa; together with various symptoms indicative of a morbid or depraved state of nutrition.

Ætiology.—Elephantiasis is endemic in India, the Malayan peninsula, China, Egypt, Arabia, the West Indies, and parts of America, chiefly in localities within the influence of the sea air; and it occurs sporadically all over the globe, excepting, perhaps, in the extreme north and south. Certain conditions of soil and climate, such as humidity, heat, malarious influences, and proximity to the sea-coast, seem to be concerned in producing the disease and influencing its development. Removal from the endemic area frequently checks the disease, whilst return there reproduces it. Elephantiasis affects both sexes, and persons of all ages and conditions of life, but more men suffer from it than women. No race is exempt, but it is much more frequent in dark than in fair races. It occurs at all ages, but is most common in adult and middle life, comparatively rarely beginning in young children or in the aged. Elephantiasis is doubtfully hereditary; but Richards found that of 236 persons, 73 per cent. had one or both parents affected. Various causes are assigned for the disease. Air, water, food, and, as it is common near the sea-coast, eating fish have been frequently credited with producing it. Certain forms of vegetation, and the geological formation of the soil, have also been regarded as predisposing and determining causes. Climate and locality, combined with bad living, are doubtless the real predisposing causes; and it is probable that, as the late Dr. T. Lewis suggested, it may be found to be intimately associated with, if not entirely dependent on, the presence in the blood of certain parasites. No race is exempt from the disease, but, whatever may be the explanation, the white suffer less than the dark races. It does occur occasionally, though very rarely, in the pure European in India, but more frequently in those of mixed descent; it will generally be found that where it occurs in persons of apparently European parentage, there is a mixture, however slight, of dark blood.

Anatomical Characters.—The hypertrophy of elephantiasis in most cases appears to be simply an increase in the natural elements of the part, the blood-vessels and lymphatics sharing in the growth. In other cases the lymphatics and lymph-spaces are most concerned, giving rise to a condition that has been described as *nævoid elephantiasis,* in which the appearance is presented of a soft and fluctuating swelling, which when punctured gives issue to a white or pinkish fluid, very closely resembling chyle. The lymphatic glands also share in the enlargement. In other respects the progress of this variety is like that of the ordinary form of the disease.

The *Filaria sanguinis hominis* is sometimes found in great numbers in the blood of persons suffering from elephantiasis; and the mosquito is considered to be the medium by which the hæmatozoon is transmitted to water, and thence to the human body; but its causal relations to the disease are not absolutely established. *See* Filaria Sanguinis Hominis.

Symptoms.—The ordinary form in which elephantiasis presents itself is hypertrophy of the integument and areolar tissue of some part of the trunk or limbs, and notably of the legs and genital organs. The skin becomes enormously thickened by hypertrophy of all the fibrous elements of its structure, attended by the deposit of a quantity of albuminous fluid in the interstices of the areolar tissue. The papillæ are prominent and much increased in size. The integument is formed into hard masses or folds, with a rugose condition of the surface, not unlike the appearance of an elephant's leg. The feet and toes are sometimes almost hidden, and the scrotum or labia form enormous outgrowths. The scrotum often attains great weight, and may be accompanied by large hydroceles. Scrotal tumours have been removed weighing upwards of 100 lbs.

The onset of elephantiasis is frequently violent and attended with great suffering. There is high fever; intense pain in the lumbar region, groin, spermatic cords, and testes, which become swollen; while acute hydroceles form. These symptoms are often attended with sympathetic vomiting, nausea, and rapid erythematous swelling of the external parts; and, if the extremities be attacked, the swelling may be tense and painful, accompanied by much effusion into the areolar tissue. The surface of the integuments is much inflamed, and sometimes discharges a serous ichor or chyle-like fluid, according to the extent to which the lymphatics are engaged in the particular case. The great tension and swelling of the spermatic cords are apt to dilate the abdominal rings so widely, that after recovery the patient may suffer from hernia.

In some cases of elephantiasis the integuments are also the seat of a dilated and turgid condition of the lymphatic vessels, which during the periods of vascular excitement, when the febrile attacks occur, give way and discharge a chyle-like fluid; in other cases the surface temporarily assumes a herpetic condition, which exudes an acrid and offensive serous fluid. *See* Chyluria.

Elephantiasis not infrequently occurs without much or any obvious injury to, or disturbance of the general health during the intervals between the febrile attacks, which in some cases are few and slight. The appetite, spirits, and strength are good, the functions are all normally performed, and the only inconvenience is that due to the size and weight of the outgrowth. On the other hand, it is frequently quite the reverse : the rapidly recurring febrile attacks, pain, exhaustion, suffering, and visceral complications induce a state of cachexia and debility sometimes so serious as to render even surgical interference impracticable. Withal, hepatic and splenic enlargements do not as a rule result from the persistence of the elephantoid fever alone; though not infrequently, as a more direct result of malarious poisoning, they seriously complicate the evils of the sufferer's condition. Albuminuria, as well as chyluria, is occasionally present.

In some cases, after the outgrowth has attained a certain bulk, it ceases to grow altogether, or increases slowly and insidiously without febrile disturbance, and in such cases the general health remains good. But there is generally a tendency to recurrence of the fever once or twice a month, when the parts affected become tense, hot, painful, and swollen, and often discharge a serous or lymph-like fluid, which may be acrid and offensive. Some tumours, on the other hand, are very slightly, if at all, so affected, and remain perfectly dry. In all cases, however, some growth goes on; and even when, as occasionally happens, fever has ceased to recur, there may be a gradual, but slow and painless, increase of the hypertrophy. The greatest variety and uncertainty obtain in the duration and progress of the growth: sometimes it is very rapid, at other times it is slow, with intermissions of activity and indolence of development. The disease elsewhere than in the genitals, unless it be accompanied by exhaustion and debility, causes no failure in the generative powers in either sex. Women may have a tendency to miscarry when suffering from elephantiasis.

Course, Duration, and Terminations.—According to Richards, the average duration of the disease, as deduced from the observation of 636 cases, was 11½ years; and he notes that the earliest age was nine years, whilst the latest at which he observed it was eighty years. It appears from this that the disease has little influence in shortening life.

Pathology.—The outgrowths in elephantiasis are the local expressions of a constitutional disease, and are not to be regarded merely from their local point of interest. They are the result of certain climatic influences whose exact nature is not at present determined; though, considering the geographical range of the area where the disease is endemic, it seems probable that, whatever other cause may be at work, the so-called malarious influences play some part in its production.

The researches of the late Dr. T. Lewis into the pathology of chyluria in India, and his discovery of certain hæmatozoa in the blood of those affected with that disease, coupled with the fact that the subjects of chyluria and hæmatozoa are also frequently, if not always, affected by elephantiasis with its febrile paroxysms, hypertrophied integument, and lymphatic disturbance, are very suggestive of a community of origin of these morbid conditions. Dr. P. Manson's investigations into the connexion of the mosquito with the transmission of the filaria are also most important and interesting.

Treatment.—Little has yet been done by constitutional treatment in cases of elephantiasis. Remedies useful during the febrile paroxysms have little power in preventing recurrence of, or in checking the disease. Iodine, combined with quinine, arsenic, and iron, has been found useful to a certain extent. During the febrile state salines, diaphoretics, and such remedies as are needed during the pyrexial state of malarious fevers, are indicated. Opium may be necessary to relieve the intense pain which often accompanies the onset of the stage of excitement. When the febrile stage has passed, quinine is useful, which, if anæmia exist, should be combined with iron. The local application of iodine, in such forms as the iodide of lead or biniodide of mercury ointment, has been thought useful; but as this is generally combined with pressure in the recumbent posture, the benefit is probably due to the latter. Such measures, along with improved hygienic conditions, may no doubt control the progress of the disease and relieve suffering. No remedy, however, is so potent as change of climate, by removal from the endemic site of the disease. This, if effected in the earliest stages, may completely arrest the disease, and perhaps even disperse any incipient structural change. This has been observed in the rare cases in which elephantiasis occurs in Europeans, who, on returning to Europe, have after a time lost the disease, and almost, or entirely, any hypertrophic changes that may have occurred. Natives of India improve if they leave the endemic area during the early stages, and go and reside in other and drier localities. However, when the hypertrophy is advanced, the paroxysms of fever are still liable to recur, even when the climate is changed, though with less violence.

Surgical treatment, when the hypertrophy is advanced, is often most successful in relieving the sufferer, not only of the local trouble, but also of the fever. Tumours of the genital organs, sometimes of enormous size, are now removed with complete success and comparatively small mortality. Before commencing the operation, especially in the case of a large scrotal tumour, it is well to drain it of blood by placing the patient on his back, and elevating the tumour on the abdomen for an hour or so, during which time pressure by a bandage (a modification of Esmarch's) may be tried, and cold (ice) may be applied. During the operation, the application of a whipcord ligature drawn tightly round the neck of the tumour also prevents loss of blood.

The removal of a scrotal tumour is effected by incisions along the course of the cords and the dorsum penis. The cords, testicles, and penis are turned out by a few touches of the knife, and then reflected and held up on the abdomen, while the mass of the tumour is rapidly swept away by a few bold incisions in the perinæum. The numerous venous and arterial bleeding points should then be arrested, and the wound dressed with antiseptic applications. No attempt should be made to preserve flaps of integument either for the penis or testes. It is unnecessary, and almost certain to be followed by recurrence of the disease. The process of cicatrisation goes on rapidly, and in from two to four months all is closed in by cicatricial tissue, which gradually perfects itself, and has no liability to become the seat of a return of the disease. Joseph Fayrer.

ELSTER, in Saxony.—Alkaline sulphated waters. *See* Mineral Waters.

EMACIATION (*emacio*, I make lean). Wasting or loss of flesh. The term is applied both to the process of wasting and to the condition that results therefrom. *See* Atrophy; and Atrophy, General.

EMBOLISM (ἔμβολον, a plug).—Synon.: Fr. *Embolie*; Ger. *Embolie*.

Definition.—The arrest in the arteries or capillaries of some solid body, which has been carried along in the course of the circulation.

Pathology.—Emboli usually consist of portions of fibrin derived from thrombi of the veins or heart, or of vegetations detached from the cardiac valves. They may, however, be formed by fragments of tumours which have grown into the blood-vessels, or of other foreign bodies, including fat, which have obtained entrance into the circulation.

The effects of embolism may be divided into two classes: First, those which are caused by the arrest of the circulation; and secondly, those which are due to any specially irritating properties of the embolus.

1. The embolus may, first, be supposed to consist of some *indifferent* substance not possessing any irritating qualities. The effects which may then be caused by arterial embolism are mainly these: First, a transient anæmia of the territory supplied by the blocked artery. This may pass away without leaving any permanent consequences. Secondly, necrosis of this territory. This may be either sudden, in the form of gangrene; or more gradual, in the form of softening or withering. Thirdly, the formation of a *hæmorrhagic infarction*, that is, congestion of the territory, followed by extravasation of blood into the tissues, and so the formation of a firm, solid patch of a dark red colour, usually of a wedge shape, with the apex towards the embolus, and the base towards the periphery. In very soft organs, as the brain, the extravasation may break down the tissue and cause the ordinary phenomena of an apoplectic clot. These hæmorrhagic infarctions undergo various subsequent changes. Usually a process of degeneration sets in;

the blood-pigment passes through its familiar transformations; the patch changes from dark red to tawny and yellow, undergoes molecular disintegration, shrinks away, and ultimately leaves a depressed fibrous patch, in which the remains of the altered blood, crystals of hæmatoidin, &c., may often be recognised. Sometimes the patch softens down into a puriform fluid, which may become surrounded by a fibrous capsule, and ultimately dry up, or even calcify. When recent, these patches are usually surrounded by a halo of congested vessels.

The cause which determines these different results of arterial embolism is, in the main, the anatomical arrangement of the blood-vessels. Supposing the embolus to be lodged in an artery which gives off anastomotic branches between the seat of the embolus and the final capillary distribution, the effect in most cases will be transient anæmia, the collateral channels will enlarge, and the circulation will be again restored. A thrombus will form on the embolus and will extend back to the next arterial branch, and the changes described in the article on thrombosis will take place in it (*see* THROMBOSIS). If the blocked artery be of large size, and supply important organs, the symptoms of temporary arrest of function of the part supplied by the artery will follow, as transient paralysis, dyspnœa, coldness of the extremities, &c., according to the artery affected. Should, however, the artery be small, and not supply important organs, no symptoms whatever will be caused; and this is the case in the majority of embolisms. Supposing, however, the artery is what Cohnheim calls a *terminal* artery—*i.e.* one which gives off no anastomotic branches between the embolus and the final capillary distribution, and that the capillary anastomosis with other arterial territories is insufficient to supply a collateral circulation, and that the presence of valves prevents the reflux of blood into the territory from the veins, it is manifest that the embolism must completely cut off the blood-supply, and consequently, in some form or other, cause necrosis of the territory.

The network of anastomosing channels is, however, so close in most parts of the body that, in order to produce this effect, it is necessary either that the main artery of the part be obstructed, or else that there be multiple embolisms blocking up at the same time several arterial branches, and so stopping the channels of collateral circulation.

The mode in which the hæmorrhagic infarction is produced is still a subject of dispute. According to Cohnheim, whose views until recently were generally accepted, the hæmorrhage is due to a reflux from the veins into the territory supplied by the blocked artery. This first causes congestion, and then extravasation, in consequence of impairment of nutrition of the walls of the blood-vessels for the integrity of which the circulation of the blood is essential. According, then, to Cohnheim, in order to produce the phenomena of the hæmorrhagic infarction it is necessary that the artery be a terminal one—*i.e.* one which gives off no anastomotic branches for some distance before its final capillary distribution, and that the veins be not furnished with valves. These conditions are met with in the spleen, the kidney, the brain, certain branches of the pulmonary artery supplying surface lobules, and the central artery of the retina; and on these grounds he accounts for the frequent occurrence of hæmorrhagic infarctions in these organs, though there is no reason to suppose that, with the exception of the lungs, embolisms are more frequent in them than in other parts.

The more recent researches of Dr. M. Litten, *Zeitschrift für klinische Medicin*, vol. i. p. 189, render, however, these views no longer tenable. He shows by experiments on the kidney, spleen, lung, &c., that if the blocked artery be a strictly terminal one—*i.e.* one whose area of distribution has no other arterial supply, the phenomena of the hæmorrhagic infarction do not occur, even though the vein have no valves; and under other circumstances that the infarction takes place although the vein has been ligatured; hence the cause of the infarction cannot be venous reflux. Thus, if both the renal artery and vein be ligatured, infarction of the kidney takes place, the kidney receiving a sufficient collateral supply of blood from other sources; but if the capsule be first stripped off, and the kidney left attached only by the renal artery and vein, no infarction takes place, though the vein is left pervious. Similar results were obtained in other organs. Hence it would seem evident that the congestion and infarction following embolism are produced by an afflux of arterial blood into the territory from collateral channels. Should these be numerous, and should small arteries open directly into the anæmic territory, the circulation will soon be restored, and no infarction will take place; should, however, the communication be imperfect, and chiefly by means of capillaries, a congestion of the territory, leading to diapedesis, and infarction will result, the *vis a tergo* being insufficient to propel the blood onwards into the veins.

Litten has also shown that the vessels in which the circulation has been arrested retain their integrity much longer than was supposed by Cohnheim; and that in the kidney, long before the vessels suffer, necrosis of the epithelium takes place, the nuclei of the cells disappear, their protoplasm coagulates, and they become converted into swollen hyaline masses (*coagulation necrosis*), which have a remarkable tendency to calcification. Hence the wedge-shaped white embolisms often seen in the kidney are not produced by decolorisation of hæmorrhagic infarctions, but are simply the result of the necrosis of the epithelium; and the halo of injection which is often seen to surround them is due to inflammatory congestion caused by the presence of the necrosed patch.

This explanation of the mode of production of the hæmorrhagic infarction is more closely in accord with the view originally propounded by Virchow, who regarded the hæmorrhage as due to collateral fluxion.

2. We have now to consider the effects of emboli which possess irritating or *poisonous* qualities, such as those derived from the puriform softening of venous thrombi in cases of septic inflammation. The mechanical effects will be the same as those of the previous class; but, in addition, these emboli set up a suppurative inflammation in their vicinity, quite independent of any obstruction of the circulation. Hence it is that we meet with pyæmic abscesses, as the result of infecting emboli, in all parts of the body, while the effects of obstructed circulation are, for the most part, confined to certain organs. Thus the liver is very frequently the seat of embolic abscesses, while hæmorrhagic infarctions do not occur there. In the lung, where in parts terminal arteries are found but for the most part there is free anastomosis, the two processes are often seen side by side. The different effects of these two classes of embolism are very manifest in the capillaries. Simple emboli, of such small size as to become first arrested in the capillaries, either cause no permanent change at all, or, at most, produce a punctiform hæmorrhage. Infecting emboli, on the other hand, give rise to the miliary abscesses so often seen in pyæmia.

W. Cayley.

EMESIS (ἐμέω, I vomit).—A synonym for vomiting. *See* Vomiting.

EMETICS (ἐμέω, I vomit).—Synon.: Fr. *Emétiques*; Ger. *Brechmittel.*

Definition.—Agents that produce vomiting.

Enumeration.—Copious draughts of Lukewarm Water, Mustard, Sulphate of Zinc, Sulphate of Copper, Carbonate of Ammonium, Common Salt, Alum, Chamomile, Tartar Emetic, Ipecacuanha, and Apomorphine.

Action.—The act of vomiting consists in the simultaneous spasmodic contraction of the diaphragm and abdominal muscles, and relaxation of the cardiac orifice of the stomach, so that its contents are expelled. When the diaphragm and abdominal muscles contract, but the cardiac orifice remains closed, so that the contents of the stomach cannot escape, the expulsive efforts are termed *retching.* The nervous centre which regulates these movements is situated in the medulla oblongata; and it may be excited either directly by the action upon it of drugs carried to it by the blood, or reflexly by irritation of various nerves. The drugs that act directly upon it have the same action, whether they are introduced immediately into the circulation or absorbed by the stomach. They may thus produce vomiting and evacuation of the stomach without being taken into the stomach at all, and on this account they are termed *indirect* emetics, although they act directly upon the vomiting centre. Such are ipecacuanha, apomorphine, and tartar emetic. Similarly the drugs that excite it reflexly are still termed *direct* emetics, because they are applied directly to the stomach. Such are the sulphates of zinc, copper, and aluminium; carbonate of ammonium; salt; mustard; and chamomile, which irritate the nerves of the stomach. Tickling the fauces with a feather, or with the finger, also excites reflex vomiting, and may be adopted either alone, or in order to aid the action of other emetics. The terms *direct* and *indirect*, therefore, as applied to emetics, relate to the stomach, and not to the centre for vomiting.

Direct emetics, as they stimulate the nerves of the stomach only, have little action except that of simply exciting vomiting. The indirect emetics, which excite vomiting by their action on the medulla oblongata, act also on other parts of the nervous system, and cause secretion of saliva, secretion of mucus from the œsophagus, stomach, and bronchial tubes, and perspiration. They also cause much nausea, depression of the circulation, and loss of nervous and muscular power. Further, the vomiting they induce is more continuous and violent, and often expels the contents of the gall-bladder, causing part of the bile to flow into the stomach, and be thus evacuated.

Uses.—Emetics are employed to remove the contents of the stomach under various circumstances. Firstly, when the food is causing irritation, and not undergoing proper digestion, as, for example, in dyspepsia or sick-headache; and in such cases large draughts of lukewarm water, of mustard and water, or of an infusion of chamomile are usually found beneficial. Secondly, in cases of poisoning; and here mustard, sulphate of zinc, and sulphate of copper are best, as they empty the stomach most quickly and effectually. Thirdly, to cause the expulsion of bile from the gall-bladder, or remove bile from the body, in biliousness, fevers, and ague. When the bile-duct is stopped by a small gall-stone, the pressure exerted on the gall-bladder during vomiting has been known to cause the expulsion of the calculus. In biliousness, excess of bile is more readily removed by vomiting than by purging, as there is no opportunity for the bile to be absorbed on its way from the gall-bladder to the mouth, whereas it may undergo absorption on its passage through the intestines. It is supposed by some that various poisons circulate occasionally in the bile, such as the malarious poison which occasions ague, and possibly certain septic poisons which give rise to fevers. The advantage of emetics in ague is undoubted, as it can certainly sometimes be cured by them without quinine, and the action of quinine is always aided by their use. They have also been recommended in the early stages of continued fevers. In such cases tartar emetic or ipecacuanha is most serviceable. Fourthly, to cause expulsion from the air-passages of false membrane in croup or diphtheria, or of secretions in bronchitis and phthisis. For these purposes ipecacuanha is the emetic most frequently chosen; but if it do not act rapidly in croup, sulphate of zinc or sulphate of copper may be employed, or a teaspoonful of powdered alum and honey. In cases of either croup or bronchitis, where there is great depression of the circulation, carbonate of ammonium may be used with advantage, as it not only causes vomiting, but at the same time stimulates the circulation.

T. Lauder Brunton.

EMMENAGOGUES (ἔμμηνα, the menses; and ἄγω, I move or expel).

Definition.—Emmenagogues are remedial agents which stimulate or restore the normal menstrual function of the uterus, when it is irregular or absent.

Enumeration.— Emmenagogues may be either *indirect*, as Iron, Strychnine, and other tonics, Warm Hip-baths, Leeches, Mustard, Aloetic purgatives, &c.; or *direct*, as Rue, Borax, Savin, Myrrh, Cantharides, Guaiacum, Apiol, Quinine, Digitalis, and Ergot—most of which, when given in larger doses, produce abortion, and are called *ecbolics*. The most efficient means, however, of obtaining this last-named action are those of a mechanical nature, so well known to obstetricians, and directed either to the actual rupture of the membranes, or to their separation from the cervix.

Action.—The *indirect* emmenagogues act by improving the quality of the blood, giving tone to the nervous system, or irritating adjacent parts or organs, from which a stimulating influence is conveyed by reflex action to the womb.

The *direct* drugs in moderate doses gently stimulate the uterus, thus promoting the menstrual flow, or even checking it when in excess; but when further pushed they may cause powerful contraction of the unstriped muscular fibre, of which its walls are mainly composed. Ergot is believed to act either directly on the muscular tissues themselves, or through the intermediate intervention of some central or peripheral nervous influence.

Uses.—Checked or retarded menstruation frequently results from anæmia or general debility, and the indirect emmenagogues will under these circumstances usually effect a cure. If, however, the case prove more obstinate, one or more of the direct emmenagogues will often restore the suspended function. Should even this do no good, some mechanical impediment probably exists, or some altered physical condition of the womb which mere drugs cannot rectify.

Robert Farquharson.

EMOLLIENTS (*emollio*, I soften).—Synon.: Fr. *Émollients*; Ger. *Erweichende Mittel.*

Definition.—Substances that soften and relax the parts to which they are applied.

Enumeration. — The principal emollient applications are: — Warm water, Steam, Poultices made of substances which retain heat and moisture, for example, linseed-meal, bread, bran, flour, oatmeal, and figs; Fatty substances, as linseed, olive, almond, and neat's-foot oil, lard, and suet; Spermaceti, Wax; Soap Liniment and other liniments; Glycerine; Paraffines; and Lanolin. To these may be added such substances as do not properly relax the tissues, but protect the surface from irritation, such as White of Egg, Gelatine, Isinglass, Collodion, and Cotton-wool.

Action.—Emollients relieve the tension and pain of inflamed parts by their action both upon the blood-vessels and upon the tissues themselves. They cause all the contractile tissues to relax and dilate, and thus, lessening pressure upon the nerves of the part, they relieve pain. They soften superficial parts by supplying them with either fat or moisture, and by increasing the supply of blood. In this way they prevent the skin from cracking after exposure to cold. When the cuticle is lost they form a covering, under which the skin may heal; and they prevent the injurious consequences of friction from without.

Uses.—Fatty emollients are used to prevent the skin or mucous membranes from cracking; to prevent irritation or ulceration between parts constantly in contact, as on the limbs of children near the joints; to prevent bed-sores; to aid the healing of blisters; or in skin-diseases, such as eczema. They are also used, especially in the form of linimentum calcis, as applications in burns and scalds, for which purpose such substances as cotton-wool are likewise frequently employed. Mucilaginous substances are useful, when swallowed, to relieve pain and irritation in the throat, and to lessen irritable cough; and such substances as figs are employed to protect the intestines from injury by hard and pointed substances which have been swallowed. Warmth and moisture are applied in the form of poultices to the surface in pustules, boils, carbuncles, and deep-seated inflammation of the limbs, and in inflammation of the internal organs (*see* POULTICE). In the form of vapour they are useful in inflammation of the air-passages. *See* INHALATIONS, Therapeutic Uses of.

T. LAUDER BRUNTON.

EMPHYSEMA OF LUNGS.—*See* LUNGS, Emphysema of.

EMPHYSEMA, SUBCUTANEOUS (ἐν, in; and φῦσα, wind). — SYNON.: Fr. *Emphysème*; Ger. *Emphysem*; *Windgeschwulst.*

DESCRIPTION.—Subcutaneous emphysema is the distension of the spaces of the areolar tissue with air or any other gas. There is thus produced a swelling, in slight cases affecting a very limited area, in extreme cases extending to the subcutaneous tissue of the whole body. Unless the tension is great, the swelling is slightly lobulated; it is elastic, and although the finger sinks readily into it, no lasting impression is left. When the area affected is small, the gas can be driven in any direction by the pressure of the hand. On palpation a peculiar fine crepitation is felt, which is absolutely diagnostic. On percussion there is superficial resonance, the note resembling that obtainable from a bladder loosely filled with air. Unless the gas causing the emphysema is the product of decomposition of gangrenous tissues, as in spreading gangrene, there is no redness of the skin. The swelling usually forms rapidly, and may extend in a few minutes over the greater part of the body. In such cases it is most marked where the subcutaneous tissue is lax. In the face the features are obliterated, and the eyes closed by the swelling of the lids. The scrotum and penis become enormously distended.

ÆTIOLOGY AND PATHOLOGY.—Wound of the lung from a broken rib or from a stab is the most common cause of subcutaneous emphysema. If from a stab, it can only occur when the opening in the pleura and that in the skin no longer correspond with each other, in consequence of an alteration in the position of the patient, or when the wound has been artificially closed. When from wound of the lung, it may occur with or without pneumothorax. Nothing is more common than to find a limited emphysematous swelling round a fractured rib, without any signs of air in the pleural cavity. This arises either from adhesions existing between the parietal and visceral layers, or from the escape of air being very limited. In severe cases with pneumothorax the mechanism of the production of emphysema is as follows: A wound in the lung always allows air to pass from it readily, but from the way in which the soft pulmonary tissue falls together, no amount of force can drive air through the wound in the opposite direction. It thus acts somewhat like the valve of an air-pump. The first effect of the escape of air into the pleural cavity is to cause collapse of the lung. As the chest expands with each inspiration air rushes from the wound in the lung into the pleural cavity; as it contracts in expiration, the air, being unable to pass back by the wound, is driven through the opening in the parietal pleura into the subcutaneous cellular tissue. In such cases there is gradually increasing dyspnœa, with great distension of the subcutaneous cellular tissue; and unless relief is given, the patient dies asphyxiated.

Emphysema occasionally occurs from rupture of some of the air-vesicles during a violent expiratory effort. Dr. Walshe states that this accident has happened from 'the efforts in parturition, defæcation, raising weights, coitus, violent coughing, paroxysms of rage, excessive laughter, and hysterical convulsions.' The air usually escapes first into the cellular tissue between the lobules of the lung, giving rise to the condition known as *interlobular emphysema.* It then finds its way into the mediastinum, and thence to the root of the neck. Interlobular emphysema gives rise to intense dyspnœa, and has been known to cause sudden death. Emphysema has also been seen as a consequence of ulceration of the trachea, and in a few very rare cases as the result of ulceration proceeding from a cavity in the lung through the adherent pleura and intercostal muscles to the subcutaneous cellular tissue.

Localised emphysema of the face is a symptom of fractures implicating the antrum.

Emphysema of the flanks is an occasional symptom of rupture of the third part of the duodenum, behind the peritoneum, and of perforation of the cæcum at its posterior part.

Emphysema of the perinæum and scrotum may arise from a wound of the bowel in the administration of an enema.

In non-penetrating wounds of the thorax and abdomen, a small quantity of air may find its way into the areolar tissue in the immediate neighbourhood, in consequence of the movements of respiration. In compound fractures emphysema is often found extending some distance above and below the wound, if the patient has been carried some distance and the injured limb much shaken.

Emphysema from the gases produced by decomposition is only seen in cases of rapidly spreading moist gangrene—*emphysematous gangrene.*

PROGRESS AND TERMINATIONS.—The effects of emphysema differ with the source of the gas. When the air comes from a superficial wound of the lung, it has no tendency to cause decomposition of the effused blood with which it may come into contact. Thus, in surgical cases, no evil consequences result from emphysema around a simple fracture of a rib. This is explained by the fact that the gas in the air-vesicles is absolutely free from solid particles of any kind, including micro-organisms, as shown by Tyndall's experiment, in which the residual air, in forced expiration, makes a gap in the beam of an electric light when breathed across it. On the other hand, air admitted from without, as in a compound fracture, tends to favour the decomposition of the effused blood, and renders treatment by occlusion or by antiseptic dressing difficult and uncertain. In ordinary cases the effused air is rapidly absorbed without causing inconvenience of any kind. If the amount of air in the tissues be very great, and the case be complicated by pneumothorax, fatal dyspnœa may occur, unless relieved by treatment.

Treatment.—The swelling itself requires usually no treatment, the gas being absorbed without difficulty. If it is complicated by pneumothorax, or if the dyspnœa be such as to threaten death, the wound, if one exists, must be opened up; or, if there is none, a free opening must be made into the pleural cavity. If the swelling be such as seriously to inconvenience the patient, a few punctures may be made with a triangular needle. Emphysema from intestinal flatus is always limited, and requires no treatment beyond that applicable to the cause of the escape of gas.

Marcus Beck.

EMPIRICAL (ἐν, by; and πεῖρα, experience).—This term is applied to treatment founded on experience, as contrasted with *rational*, which is founded on scientific reasoning. *See* Disease, Treatment of.

EMPROSTHOTONOS (ἔμπροσθεν, forwards; and τείνω, I stretch).—A bending or drawing forwards of the body, due to tonic contraction of the muscles, observed in some cases of tetanic convulsions. *See* Tetanus.

EMPYEMA (ἐν, in; and πύον, pus).—Strictly speaking, this term signifies a collection of pus within the cavity of the pleura, but it is often conventionally used to denote any inflammatory effusion in that situation which has assumed a chronic character. *See* Pleura, Diseases of.

EMS, in Germany.—Thermal muriated alkaline waters. *See* Mineral Waters.

ENCEPHALITIS (ἐγκέφαλος, the brain). Inflammation of the brain and its membranes; or, more properly, inflammation of the brain-substance itself. *See* Brain, Inflammation of.

ENCEPHALOCELE (ἐγκέφαλος, the brain; and κήλη, a tumour).—A hernial protrusion of a portion of the brain-substance through an opening in the skull, which may be either congenital or the result of accident, of surgical operation, or of disease. *See* Brain, Malformations of.

ENCEPHALOID (ἐγκέφαλος, the brain). A form of cancer, so named on account of its obvious resemblance to brain-tissue. *See* Cancer.

ENCHONDROMA (ἐν, in; and χόνδρος, cartilage).—A new-growth consisting of cartilaginous tissue. *See* Tumours.

ENCYSTED (ἐν, in; and κύστις, a bladder).—Contained within a cyst. A term applied to new-growths or collections of fluid thus enclosed, or limited by adhesions.

ENDARTERITIS (ἔνδον, within; and ἀρτηρία, an artery).—Inflammation of the internal coat of an artery. The disease is generally chronic or subacute, rarely acute. Two special forms of endarteritis have been described—namely, *endarteritis deformans*, or atheromatous disease (*see* Arteries, Diseases of; and Atheroma); and *syphilitic endarteritis*, which frequently affects the vessels of the brain. *See* Syphilis; and Brain, Vessels of, Diseases of.

ENDEMIC (ἐν, in; and δῆμος, a people). This term is applied to diseases that prevail in particular localities or districts, and which are due to special ætiological conditions existing there. *See* Disease, Causes of.

ENDERMIC MEDICATION (ἐν, in; and δέρμα, the skin).—Fr. *La Méthode Endermique*; Ger. *Intracutane Arzneiapplication.*

Definition.—The method of using remedies either by rubbing them into the skin or by sprinkling them on a surface which has been previously denuded of its epidermis.

Endermic medication was strongly advocated and practised by Lembert, Valleix, Trousseau, Anthony Todd Thomson, and others, but it has almost, if not entirely, given place to hypodermic injection, (1) because the endermic method is the more painful; (2) because it is slower in action—thus, Trousseau found that twelve minutes were required for one-sixth of a grain of morphine endermically administered to take effect, whereas, hypodermically, the action of the same dose is observed in less than one minute, in fact, almost immediately; (3) because in many parts of the body endermic medication is totally inapplicable.

Method and Uses.—The epidermis should first be detached either by some ordinary vesicant, such as cantharides plaster, or by the application of a cautery. The drug to be used is then laid on the raw surface in the form of powder rubbed up with starch, sugar, sulphate of sodium, or some other unirritating substance, paste made with water or thin mucilage, or ointment. In this way, neuralgia, sciatica, and other painful affections may be treated with the morphine salts in doses of one-sixth of a grain and upwards; local paralyses and other nerve-troubles with strychnine in doses of one-fiftieth of a grain and upwards; and many other alkaloids may be used in the same way in various diseases.

A. S. Currie.

ENDOCARDITIS (ἔνδον, within; and καρδία, the heart).—Inflammation of the lining membrane of the heart. *See* Heart, Inflammation of.

ENDOGASTRITIS (ἔνδον, within; and γαστήρ, the stomach).—Inflammation of the mucous membrane of the stomach. *See* Stomach, Diseases of.

ENDOMETRITIS (ἔνδον, within; and μήτηρ, the womb).—Inflammation of the lining membrane of the uterus. *See* Womb, Diseases of.

ENDOPERICARDITIS.—Inflammation of the endocardium and pericardium together. *See* Heart, Inflammation of; and Pericardium, Diseases of.

ENDOSCOPY (ἔνδον, within; and σκοπέω, I look).—Definition.—The inspection of internal surfaces. Taken inclusively, this definition comprises ophthalmoscopy, otoscopy, laryngoscopy, rhinoscopy, urethroscopy, cystoscopy, and inspection of the gullet, stomach, and rectum. But in ordinary parlance, the word signifies inspection of the urethra only; special terms being used when inspection of other parts is meant.

Introduction.—An internal surface may be illuminated by letting light, such as daylight, fall through a straight tube (*direct illumination*); or by rays collected and thrown by mirrors placed conveniently through a tube on to the surface to be examined, and reflected directly to the eye of the observer, or through lenses set at suitable angles (*reflected illumination*); or, lastly, by light generated within the body and reflected to the eye of the observer (*internal illumination*). This last method, in which the electric lamp was placed at the inner end of the tube, and its light thrown directly on to the exposed part, has been abandoned for examining the urethra, on account of the difficulty in shielding that canal from the heat of the glow-lamp; though it is still the mode of illuminating the bladder or other cavities, the walls of which are not in contact with the instrument.

The present mode of examining the urethra and other surfaces is the outcome of the work of many experimenters, the earliest of whom was probably Bozzini (1807), followed by Segalas in 1826. In 1840–46, Avery of London devised the tubes which are still in general use. But the methods of illumination now employed, by gas or electricity, are far superior to those obtainable in Avery's time. Desormeaux improved Avery's method of illumination, and this was further bettered by Cruise. Still, the apparatus remained too cumbrous for easy use until Grünfeld simplified the application of illumination between 1875 and 1880, and Leiter between 1880 and 1887 perfected the electric method by reflecting light from a glow-lamp along the tubes on to the exposed surfaces. About this time Grünfeld, Dittel, and others, employing these more manageable instruments, were able to describe methodically the appearances of the normal urethra in its several parts, and also many of the changes caused by disease.

Apparatus.—The apparatus may be arranged in three varieties: in Desormeaux' and Leiter's the lamp and tube are fixed together; in a second, the light is distinct, but the reflectors and lenses are fixed to the tube; in a third, the light and reflector, a concave mirror fastened to the forehead or held in the hand, are both separate from the tube.

The best apparatus is that of Leiter, where the light of an Edison's glow-lamp of 0·5 to 1 ampère is affixed below the outer end of the tube, and its rays reflected through the tube on to the exposed portion of the urethra and back again to the eye of the observer. It comprises a set of straight silver tubes five inches long and of internal diameter ranging between 18 and 26 millimètres. Their inner ends are cut off either transversely or obliquely, and the outer ends have a wide mouth and flange, on to which the funnel and mirror may be fitted. Each tube has a vulcanite plug with a smooth or rounded end that projects beyond the tube, to facilitate its passage along the urethra. The interior is blackened to prevent confusion by reflection from its sides. Dr. William K. Otis, of New York, has contrived curved tubes which can be passed along the urethra to the posterior portion with ease; but curved tubes require a reflector at the end, and the one supplied with the tubes is too clumsy to be of much service. Grünfeld has improved the windowed tubes of Avery—that is, tubes with some part of the side or the end closed by a piece of glass—and for some purposes these windowed tubes are more useful than the open ones. In addition to tubes, lamps, and mirrors, small mops of cotton wool are needed to wipe the mucus, pus, and blood from the displayed surfaces, so that the cleaned and dried membrane may be viewed. For the treatment of the various affections, additional armamenta are strong astringent or caustic solutions, hæmostatics, such as hamamelis, iron, or tannin, and pencils of cupric sulphate or of lunar caustic. To them may be added small electric cauteries, probes, forceps, snares, knives, scissors, curettes, and tubes for insufflation of astringent powders. Grünfeld has also contrived to place outside his endoscopic tube another fine one, through which he can inject drops of astringent solutions on to inflamed patches.

Batteries of various make are used: that for illumination should have a power of eight to twelve volts; that for cautery, of twenty to thirty volts. Carbolic oil (1 in 16) or glycerine for lubricating the tubes is also needful.

Application.—When inspecting the urethra it is convenient to divide the canal into two portions—that before the triangular ligament being the anterior, that behind it the posterior. Not infrequently the inflammation set up by gonorrhœa is confined to the anterior portion; while, on the other hand, in gleets of long standing the posterior part may be alone affected, when the anterior section is quite clear of disease.

In the anterior portion are the meatus and the fossa navicularis, the spongy and bulbous parts, into which, with a forward direction, open the ducts of mucous glands and those of Cowper's glands. In the posterior are the verumontanum, the sinus pocularis, and the openings of the spermatic ducts and of those of the prostate itself.

Before examining the urethra, it is advisable to pass along the canal a sound or bougie slightly larger than the inspecting tube, in order to be sure that no constriction exists which would prevent the passage of the tube, and also to familiarise the urethra with the presence of instruments. It is well also to refrain from introducing the tube into the posterior portion until that part has become accustomed to instruments by the repeated passage of bougies or sounds. The calibre of the tube should not be large enough to stretch the urethra; if it is, the walls are more or less blanched, and the operation is apt to give pain. These drawbacks avoided, the larger the tube the more easy the examination.

Examination of the anterior portion of the urethra.—The best position is the half-recumbent one on a high couch, with the knees bent and the legs hanging over the edge. The observer seats himself on a low stool opposite his patient, his eyes about level with the urethra. If the patient be well accustomed to manipulation he may stand upright on a stool against a wall, to bring his pelvis level with the eyes of the observer sitting before him. All being ready, the operator introduces the tube. If the meatus be much contracted, either congenitally or by fibrous bands after inflammation, it is well to divide the tight bands by the touch of a probe-pointed bistoury, after rendering the part insensible with cocaine. A No. 24 or 26 tube, with its plug, is then slowly passed along the passage until the bulb is reached. The plug is then withdrawn, and the area of the urethra exposed at the end of the tube is well mopped and dried, and the light adjusted. If the urethra is healthy and not scarred or blanched by previous inflammation, the part now seen is of a delicate rose-pink or purplish pink hue, faintly striated with longitudinal lines. The most distinct streaks or furrows are in the floor at each end of the transversely disposed lumen. Faintly marked crimson papillæ are visible in the anterior portion, but are lost near to the navicular fossa. As the tube is slowly withdrawn, the urethra collapses closely behind it evenly on all sides. The lumen or central figure is an even transverse line or slightly oval figure of symmetrical thickness. The orifice of a lacuna Morgagni is indicated by a little dark dot; though these lacunæ may be difficult to distinguish unless sought for in the way to be described presently. When inflamed, ulcerated, or indurated, these openings are easily distinguished. As the tube continues to retreat at about three inches from the meatus, the colour of the mucous membrane grows paler in many persons, to become again dull pink or bluish pink at the sinus navicularis. Here, also, the lumen changes from a transverse position to a vertical one, being oval or triangular in form. In the roof of the urethra it is not difficult to detect in this fossa the mouths of two or three or more ducts of muciparous glands, and the wall of the passage is not so evenly resilient as it is more posteriorly. To find the lacunæ Morgagni in a healthy urethra, it is often necessary to slightly divert the tube from the axis of the urethra to cause the wall to bulge slightly into the open end of the tube. By this, a larger area of the wall is brightly illuminated. If a lacuna be within the illuminated area, it is distinguished by a dark dot due to want of reflexion, because the floor of the lacuna is lower than the general surface. So, also, the position of a lacuna is revealed during slow retraction of the tube by the sudden appearance of a fine furrow or seam in the wall, radiating from the lumen and made more distinct by the greater brilliancy of the light reflected from each side of the furrow. Very shortly the seeming furrow or line disappears as the tube passes from it. The openings of the ducts of Cowper can be more easily found, as they have a more constant position in the urethra. They open into the bulbous portion, where they appear as two dark dots, side by side, soon after the lumen has assumed its transverse linear form.

Examination of the posterior portion of the urethra.—In this portion, proceeding from behind forwards, are to be seen the os internum urethræ, the walls of the prostatic portion, the verumontanum, the openings of the prostatic ducts and of the ejaculatory ducts, and the membranous portion of the urethra.

The ordinary straight tube with open end, five inches long and of the calibre suitable for the anterior part of the urethra, is the best to use for this purpose. A special movement is required to pass the tube through the triangular ligament without exciting contraction of the voluntary muscles which encompass that portion of the canal, and which resist the passage of the tube, and thereby hurt the patient.

In introducing the tube, the end rounded by the plug should be pressed gently down the urethra so that it follows the floor, not the roof, until it reaches the triangular ligament. There, while steady pressure is maintained, the hand is lowered deeply between the thighs until the deeper end rises and slips on in spite of the slight resistance always made to its onward passage. When resistance ceases, the tube is pushed backwards for another inch or so, and held steadily while the plug is withdrawn and the light adjusted. If this is done slowly, the pain, should the patient feel any, ceases as soon as the instrument stops moving. It is often well to get the patient to hold the tube himself during the adjustment of the lamp, as he is less likely than the operator to move it inadvertently. But a steady, gentle pressure must be kept on the tube while it is in this region, or it will be ejected by the muscles of the urethra, and will be suddenly thrust forth into the bulbous portion. The part being well wiped and the light thrown on, this portion of the urethra will appear funnel-shaped, and of full rosy hue or pale purple, or yellowish white if there have been inflammation or induration of the prostatic portion at some time before. At the os internum the lumen is long, horizontal, and marked at each end by two radiating creases. If now the tube be pushed back a little, it is quickly filled by urine, and a misty yellow light is all that is visible. This accident is easily avoided by practice; but if it happens, the tube must be withdrawn a little, and its outer end depressed that the urine may flow out. This done, the mops dry up the remaining moisture, and the inspection may begin. Besides the conditions already mentioned, in some cases fine longitudinal striæ or creases are seen to radiate pretty uniformly from the centre. These are probably rows of fine papillæ along shallow folds of the membrane. The tube is slowly withdrawn, bit by bit; and, as it recedes, here and there a dot or depression may be noted placed in no definite position on the wall. These dots are orifices of ducts of the prostate. Gradually, while the end of the tube recedes, there rises into view a saddle-shaped eminence like an inverted U, with the top at the highest point of the exposed surface, around which the walls closely conform. This is the verumontanum, or caput gallinaginis. It has usually a paler colour than the wall, but is never white unless diseased. Presently, when the saddle-shaped eminence is at the highest, two small red fossæ or furrows can often be seen on either side of the central ridge, and equidistant from it. These are the outlets of the ejaculatory ducts; and usually near them, but more outward, some more dots appear, signifying the orifices of the prostatic ducts. Occasionally, if the tube be kept still or pressed firmly against the floor, a little whitish-grey bead forms on one of the symmetrically placed hollows. This is semen, and, if wiped away and put under the microscope, is seen to contain the characteristic spermatozoids. Not infrequently the mouths of the ejaculatory ducts are not found by this method. They may then be generally detected by pushing the tube back a little and pressing it up against the roof to allow the floor to rise more. If the outer end of the tube be now raised, the light shines more strongly on the veru, and as the tube recedes the furrows generally become distinct. When they are clearly seen, a fine whalebone bougie or silver probe may, it is said, sometimes be coaxed into them for a short distance. On still further withdrawing the tube the saddle-shaped eminence widens at its base, the lumen loses the shape of an inverted U, and grows circular or oval, with the long diameter vertical. The walls also rise up into the area before the tube, and have a paler hue, making a broad pinkish ring inside the tube. When this appears, the membranous portion has been reached. If there have been bygone inflammation of the part, the ridge of the veru, instead of being like an inverted U, is like an inverted V, and of much lighter colour, even white, from induration and wasting. Small veins, showing as dark sinuous lines, are not uncommonly seen in the prostatic portion, and, but less frequently, in the anterior portion also.

Berkeley Hill.

ENEMA (ἐνίημι, I inject).—Synon.: Lavement; Clyster; Fr. *Clystère*; *Lavement*; Ger. *Klystier*.

Definition.—An enema is a liquid injected by means of a suitable instrument into or through the rectum.

Instruments.—Various instruments are used for the administration of enemata: 1. A simple elastic bottle with ivory or gum-elastic pipe, which has superseded the old bladder and pipe. 2. An indiarubber bottle with flexible tube at either end and double action, as in Higginson's instrument. 3. An ordinary piston syringe, worked by the hand, which is either simple, or provided with a double action, so as to supply a continuous stream. 4. A French instrument, known as the *irrigateur*, worked by a spring. 5. The hydraulic enema, which consists of a piece of indiarubber tubing about six feet long, furnished with an ordinary ivory rectum-pipe at the one end, and a metal cone, or a screw nozzle, at the other. The tube, being filled with the injection, has one end placed in the containing reservoir, or is connected by the screw; while the pipe at the other end is introduced into the bowel. The vessel supplying the injection being placed on an elevation, the liquid gravitates into the bowel, filling the large intestine. When it is desirable to inject a large quantity the patient should lie first on the left side, then on the back, and lastly on the right side, to promote the filling of the intestine. In all cases care should be taken to prevent the injection of air into the bowel, and also to ascertain that the nozzle of the injecting pipe is free in the rectum, not in contact with the sphincter, not thrust against the sacrum or into a hard fæcal mass. The process of injection must be carried on slowly, with occasional pauses, otherwise premature contraction of the bowel with expulsion of the enema will result.

Varieties and Uses.—The chief varieties and uses of enemata are as follows:—

1. **Anthelmintic Enemata.**—To cure thread-worms injections of salt and water, or lime-water, or from two to four drachms of spirit of turpentine diffused by yolk of egg in four ounces of water, are serviceable. The enema of aloes or of asafœtida may also be employed in the small quantity just named.

2. **Antispasmodic Enemata.**—Puerperal convulsions have been relieved by the injection of half a drachm or more of chloral hydrate. Injections of asafœtida or of rue are also given. Injections of warm water with two or three fluid-drachms of sulphuric ether have sometimes relieved spasmodic invagination of the bowels. When the intestine is tympanitic and distended, the enema terebinthinæ, or enema asafœtidæ, will act well as a stimulant and carminative.

3. **Astringent Enemata.**—These are used either to check diarrhœa, to arrest hæmorrhage, or to remedy ulceration and mucous discharges. For the first of these purposes the enema opii is valuable. In cases of hæmorrhage from the bowels, as well as from the womb, injections of ice-cold water are frequently used. Ulceration with mucous discharge is often successfully treated with enemata of nitrate of silver (five grains to one pint of distilled water), of sulphate of zinc or alum (one or two grains to the ounce of water), or of sulphate of copper (one grain to the ounce of water).

4. **Emollient Enemata.**—Demulcents, such as decoctions of starch, linseed, or barley, or pure linseed oil, are at times used with the object of imparting nourishment to the system, and of soothing an irritable mucous membrane.

In dysentery, from four to six pints of warm water, or of milk and water, have been injected as a form of internal fomentation.

5. **Nutrient Enemata.**—In cases of exhaustion, enemata of peptonised milk, beef-tea and eggs beaten up are used. About four or six ounces should be given at once by means of an indiarubber bottle with an elastic-gum rectum tube. When properly given, they will remain and be absorbed. Should the rectum become irritable, the irritability may be often lessened by adding a few drops of laudanum to each enema. A solution of defibrinated blood, in its recent or dried form, has been recommended as a material for nutrient enemata (*see* paper by Dr. Sansom on Supplementary Alimentation, *Lancet*, 1881, vol. i. p. 288). The digestion and assimilation of nutrient enemata may be facilitated by the addition of preparations of pancreatin and pepsin. *See* Peptonised Food.

Injections of brandy and water, or beef-tea and brandy, have been given with benefit in prostration from uterine hæmorrhage or other causes.

6. **Sedative Enemata.**—These are often employed in painful affections of the rectum and bladder. The enema opii is very useful. In spasm of the bowels and in hernia the enema tabaci has been resorted to, but it must be used with caution, as it may produce faintness and collapse.

7. **Purgative Enemata.**—These are used to overcome constipation. For this purpose—in the case of an adult—from one to two pints of fluid must be slowly pumped into the bowel. When the process is conducted gradually, stopping occasionally and making pressure on the anus if the injection threaten to come away, as much as four or five pints can be got into the bowel. The injection should be retained as long as possible, as thus a complete evacuation is ensured. As a general rule, about a pint of liquid is enough for an adult; for an infant an ounce; for a child of four years, four to six ounces.

Composition.—Soap and water, gruel with olive-oil, castor-oil, and sometimes oil alone, may be used. The enema magnesii sulphatis is an efficient purgative. Enema aloes is also valuable.

Glycerine is now used in cases of defective action of the bowels. From one to two drachms are injected by a suitable syringe into the rectum, and in from five to thirty minutes action of the bowels will follow. There is often more or less straining, with expulsion of flatus; and, if the quantity used be too large, violent and spasmodic action may result.

Glycerine suppositories have been added to the Pharmacopœia. Their action is attended with less spasm than is that of the fluid injection. The glycerine acts as a stimulant and irritant to the rectum; for while some amount of burning is felt, a thermometer shows increased temperature in the rectum. Where the accumulation lies high up in the intestine, glycerine injection has little or no effect in causing its expulsion.

In cases of intestinal obstruction the introduction of a large volume of soap and water —with oil, perhaps, added—by means of the gravitation-tube, may be had recourse to with advantage. Obstruction due to impacted fæces generally yields to this method of treatment, especially if assisted by judicious massage of the abdomen.

The gradual injection of air by means of a bellows and rubber tube, or a Lund's insufflator, into the large intestine has proved a successful method of treating intussusception of the bowel in young children, especially in cases where the intussusception can be easily felt by the rectum, and where enemata are at once returned. *See* Intestinal Obstruction.

The frequent use of very large injections is undesirable, lest undue distension result, with weakness and loss of tonicity in the bowel. The habitual use of injections washes away the mucus designed to lubricate the bowel.

John C. Thorowgood.

ENGADINE, UPPER; in Switzerland.—A bracing mountain climate. Elevation of valley 5,000 to 6,000 feet. Season, June to September. Some places are also open during the winter. *See* Climate, Treatment of Disease by.

ENGHIEN, in France. — Sulphur waters. *See* Mineral Waters.

ENGLISH CHOLERA.—A synonym for simple cholera or choleraic diarrhœa. *See* Choleraic Diarrhœa.

ENGORGEMENT.—Overloading of the vessels, or of the heart, with blood. A synonym for congestion. *See* Circulation, Disorders of.

ENTERALGIA (ἔντερον, the intestine; and ἄλγος, pain).—Synon.: Enterodynia; *Neuralgia mesenterica vel mesaraica*; Colic.

The terms enteralgia and colic—generally regarded as synonymous—include all forms and degrees of paroxysmal intestinal pain in cases where there is no febrile disturbance. Enteralgia, implying more especially the neuralgic nature of the sensori-motor disturbance, is sometimes preferred, as by those who hold that colic proper—of which lead-colic is a typical example, as distinguished from symptomatic colicky pains—is a visceral neuralgia. It is likewise frequently applied to colic occurring in the neurotic—in whom there is not uncommonly a record of other forms of neuralgia in the individual or family history—the asthenic, the anæmic, or the gouty, even when there is a local exciting cause, such as flatus, retained fæces, &c.; and to conditions in which pain predominates over spasm. The clinical features of enteralgia are, however, as a rule, indistinguishable from those of colic. A similar local disturbance—pain either sudden and sharp or gradual and dull, either about the umbilicus or in the right iliac region—according to its intensity, is reflected by the nerves to the heart and the peripheral arteries. The action of the former becomes slow and feeble, and the latter contract; hence arising the small, infrequent, tense pulse, the cool pale skin, and the other signs of collapse which mark the distant effects of colic. And, as in this disorder, the termination of the attack may be sudden, perhaps following the expulsion of flatus or fæces—a free perspiration, a copious flow of pale urine, the menstrual or lochial or other discharge, or a fit of the gout. As a rule, the more severe the paroxysm the shorter will be its duration. The exciting cause is not uncommonly a chill (wet feet, &c.), or mental over-strain and worry. Persistent enteralgia is now and then indicative of spinal disease, such as caries.

Treatment.—The main indications in the treatment of enteralgia are to endeavour to remove any cause of the pain: to administer opium or belladonna by the mouth or rectum, or subcutaneous morphine, and to apply hot fomentations, with laudanum and turpentine, for the relief of the suffering (*see* Colic, Intestinal); and, during the intervals between the seizures, to restore the nutrition and tone of the nervous system, and improve the general health. Among medicines, courses of the hypophosphites, belladonna, quinine, and arsenic may be found most useful.

George Oliver.

ENTERIC FEVER.—A synonym for typhoid fever. *See* Typhoid Fever.

ENTERITIS (ἔντερον, the bowel).—Inflammation of the intestines. *See* Intestines, Diseases of.

ENTEROCELE (ἔντερον, the bowel; and κήλη, a tumour).—A hernia containing a portion of bowel. *See* Hernia.

ENTOPHYTE (ἐντός, within; and φυτόν, a plant).—A plant parasitic in any part of the body. *Entophytic diseases* are diseases that are supposed to depend upon the growth of such plants, as, for example, fungus-foot. *See* Fungus-Disease of India.

ENTOZOA (ἐντός, within; and ζῶον, an animal).

Man, in common with other animals, vertebrate and invertebrate, is liable to entertain various forms of entozoa. In comparison with other vertebrates, even with members of his own order, Primates, the number known to infest man is singularly small. This is attributable in a large measure to the fact that his food is submitted to the process of cooking. The various entozoa found in the human subject are truly parasitic, and not examples of commensalism. A *parasite* inhabits a living organism, and obtains nourishment from its body. In *commensalism* creatures live within the bodies of larger animals, like parasites, but share its food, or live upon the refuse of its body instead of the juices and tissues of the host. The more important entozoa found in man are:—

I. *Cestoda*, Tapeworms.
II. *Trematoda*, Flukes.
III. *Nematoda*, Round-worms.
IV. *Gregarinidæ*, Psorosperms.
V. *Rhizopoda*, Amœba coli.

I. Cestoda, or Tapeworms (κεστός, a girdle).—Fr. *Cestoïdes*, *Ténia*; Ger. *Bandwurm*.

Varieties:—

a. *Tænia solium.*
b. *Tænia mediocanellata* vel *saginata.*
c. *Tænia bothriocephalus latus.*
d. *Tænia cucumerina* vel *elliptica.*
e. *Tænia nana.*
f. *Tænia echinococcus.*

a. *Tænia solium.*—This worm when fully developed may attain a length of 2 to 3 feet. The vertex or head, about the size of a small pinhead, is furnished with four suckers, a rostellum, and twenty-six hooklets (fig. 34). A narrow neck succeeds the head, and at a short distance the segments begin to be visible. At first their breadth exceeds their length; but farther from the head they lengthen, until the mature segments are reached. These average 12 mm. in length and 5 mm. in width.

Each mature segment contains male and female generative organs. The genital openings are at the sides of the segments near the middle: the ovary presents seven to ten branches, each ending in a dendritic manner (fig. 36).

T. solium inhabits the small intestine of man, and is acquired by eating pork. Infection takes place in the following manner: The eggs, either free or contained in the segments (proglottides), are evacuated from the host, and are conveyed either by means of food or drinking-water into the body of a pig or other animal. When the eggs reach the stomach of the pig the capsule is dissolved, and the liberated embryo makes its way into the wall of the intestines or is carried by the blood-current into other parts of the body. The young tapeworm, when it emerges from the egg, possesses six hooklets, and is known as the 'six-hooked embryo.' After settling in the tissues it becomes metamorphosed, and is now furnished with a head and becomes enveloped by a membrane. In this condition it is known as a 'measle' or *Cysticercus cellulosæ* (κύστις, a bladder; and κέρκος, a tail) (fig. 32). Pork containing the cysticercus is said to be 'measled.' The cysticerci are destroyed by thorough cooking, either by boiling or the more satisfactory process of roasting. When a cysticercus is introduced into the intestine, the head (scolex) fixes itself into the mucous membrane, the cyst-membrane is dissolved, a chain of segments or proglottides develop, and a tapeworm is the result.

The cysticercus occurs also in man, and is probably due to the introduction of the eggs of *T. solium* into the stomach. Cysticerci have been found in the aqueous and vitreous chambers of the eye, in the subcutaneous tissue, and in muscles. When encysted they retain their vitality for many years. The presence of these small bodies excites local irritation, inducing inflammatory thickening. In muscles and intermuscular tissue they occasionally cause swellings resembling tumours. In the brain, when numerous, they induce fatal results. A few may exist in the cortex of the cerebrum without producing any obvious effect, but in the neighbourhood of the medulla two cysticerci have been known to cause death. In the eye cysticerci have been detected by means of the ophthalmoscope. In this situation they present a striking and characteristic appearance.

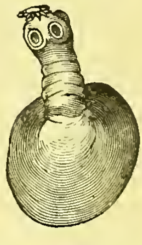

Fig. 32. — *Cysticercus* (*telæ*) *cellulosæ*, removed from the human eye by Mackenzie. × 5 diam. After Allen Thomson.

b. *Tænia mediocanellata* vel *saginata.*—This tapeworm differs from *T. solium* in several important particulars. When fully developed it may attain a length of 4 feet. The segments are thicker and wider than in *T. solium*; it has no rostellum or hooklets, but four suckers or proboscides and a median canal (fig. 33). The mature segments have a larger number of uterine diverticula, and they do not end dendritically (fig. 35). The cysticercus of this tapeworm infests the muscles of oxen. The tapeworm itself is acquired by man in consequence of eating underdone beef. In the accompanying sketches the heads and proglottides of *Tænia solium* and *Tænia mediocanellata* are arranged side by side for comparison.

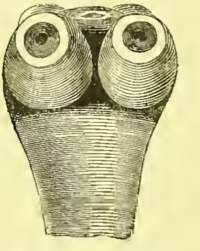

Fig. 33.—Unarmed Head of *Tænia mediocanellata.* × 10 diam. After G. Fritsch.

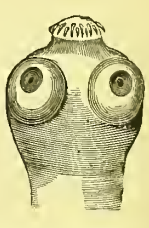

Fig. 34.—Armed Head of *Tænia solium.* × 10 diam. After G. Fritsch.

c. Tænia bothriocephalus latus.—This is the largest tapeworm infesting man; when mature it attains a length of 5 to 8 feet, and contains two, three, and even four thousand segments. The uterus has the form of a coiled ribbon, and the genital opening is near the middle of the ventral surface.

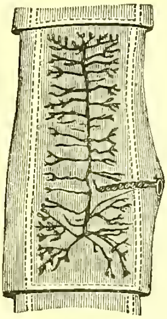

Fig. 35.—Proglottis of *Tænia mediocanellata.* × 1½ diam. After G. Fritsch.

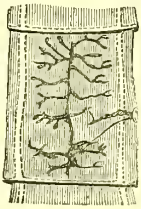

Fig. 36.—Proglottis of *Tænia solium.* × 1½ diam. After G. Fritsch.

This worm lives in the small intestine, and is met with mainly in Switzerland and north-eastern Europe. It has been reported as occurring in Ireland.

It has long been suspected that fish were the intermediate host of this cestode, and Braun has demonstrated its occurrence in the larval stage in the muscles and viscera of pike, trout, and turbot.

d. Tænia cucumerina vel *elliptica.*—This is a small tapeworm, common in cats and dogs, rarely found in man. It has a rostellum and about sixty hooklets arranged in four irregular rows. The intermediate host is the dog-louse, *Trichodectes canis.* This fact explains the large number of tænia found in dogs not cleanly kept. The lice worry the dog, and it licks the irritated parts, and thus takes the lice with the cysticerci into the alimentary canal. Stroking dogs, or receiving their lingual caresses, is probably the means by which man is infected. It is noteworthy that children have furnished nearly all the specimens of this worm which have been reported in the human subject.

e. Tænia nana.—This is a small tapeworm. The head has four suckers, a rostellum, and circlet of twenty-two to twenty-eight hooklets. Bilharz found it in great numbers in the duodenum of a boy in Egypt. It is very rarely entertained in the alimentary canal of man.

Symptoms.—The presence of tapeworms is indicated by a great variety of symptoms. Among the more important may be mentioned interference with the digestive process, irritability, and restlessness at night. Anæmia, headache, and vertigo are not uncommon. Irritation about the anus is sometimes a source of annoyance. Reflex phenomena, such as chorea, convulsions, or epileptiform seizures, insanity, mania, squint, and other untoward conditions, have been known to coincide with the presence of tapeworms in the alimentary canal, and to disappear when the worms have been expelled. Many other grave phenomena have been attributed to their presence. It is equally true that hundreds of individuals entertain tapeworms and suffer no inconvenience in consequence, nay, even are unaware of their guests until apprised of the fact by the appearance of two or three feet of cestode segments passed *per anum.*

Treatment.—Many drugs have been recommended, such as turpentine, kousso, kamala, areca-nut, and other anthelmintic remedies. The late Dr. Cobbold, after a long experience, came to the conclusion that the liquid extract of male fern is the most reliable drug. The patient, if adult, should take a dose of castor-oil at night, a drachm of extract early next morning on an empty stomach, to be followed in three hours by a small dose of castor-oil. The fragments of worms should be examined in order to ascertain if the head be expelled.

f. Tænia echinococcus and *Hydatids* (ὑδατίς, a drop of water).—Fr. *Hydatide*; Ger. *Blasenwurm.*—Tænia echinococcus is especially interesting because its larval stages occur in man under the name of hydatid cysts.

The mature tænia inhabits the intestine of dogs, jackals, and wolves. It is about 4 mm. in length, and consists of only four segments, of which the terminal one alone is mature. Its head has four suckers, a rostellum, and two rows of hooklets, varying in number from fourteen to twenty-five in each row.

The eggs of this worm are introduced into the alimentary canal with the food, but more commonly with drinking-water. The six-hooked embryo, emerging from the egg, makes its way into surrounding tissues, and is frequently carried along by the blood-current in the veins as an embolus, to find a resting-place in lungs, kidney, liver, omentum, or brain, and becomes gradually transformed into an hydatid cyst.

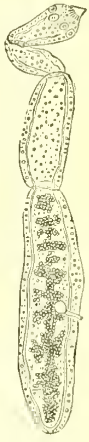

Fig. 37.—*Tænia echinococcus.*

For the history of the early stages of these cysts we are indebted to the zeal and industry of Leuckart. At first they are small white dots, with thick, homogeneous, transparent capsules, with concentric lamination, enclosing coarsely granular contents (fig. 38). After the cyst has been growing five months, and has attained a diameter of half an inch, echinococcus-heads begin to bud from its walls. Each of these heads, when fully formed, is about 0·3 mm. in length when fully distended. and represents the head and neck of an adult echinococcus (fig. 39). Each head is furnished with four suckers and an armed rostellum, the hooklets of which are very small. Numerous calcareous particles are lodged in its parenchyma. The rostellum with its hooks and suckers can be retracted and extended. In examining such specimens under the microscope it is usual to find them in the inverted or retracted condition shown in fig. 40. The heads or scolices are formed within brood-capsules, and Leuckart emphatically states that they are throughout life directly continuous with each other by means of the parenchyma of the main cyst, and cannot roam about the cavity and retain their vitality. The walls of hydatids consist of two layers, an outer or cuticular and an inner layer or parenchyma. The cuticular layer is highly elastic and curls up when divided; the parenchyma consists of granular matter, cells, and muscle-fibre. The brood-capsules are developed from the parenchyma; each brood-capsule, like the parent-cyst, has two layers, an *outer* parenchymatous and an *inner* cuticular, thus reversing the conditions of the mother-cyst. Leuckart maintains that the scolices bud from the outer wall of the capsule; but when fully developed invaginate, so that what was formerly the internal cuticular surface of the head now becomes external. This view requires confirmation. The mother-cyst grows larger as fresh brood-capsules are formed. Every echinococcus cyst does not develop brood-capsules, and may attain a large size yet remain sterile. The presence of the cyst irritates the surrounding structures, and leads to the formation of a spurious capsule of fibrous tissue, sometimes of great thickness and usually very vascular. The brood-capsules, with their contained scolices, occur in clusters; each capsule is of the size of a No. 5 shot. Occasionally the capsules become much larger and form internal daughter-cysts attaining in some specimens the size of a Tangerine orange. Such daughter-cysts may develop cysts of their own, or granddaughter-cysts. When endogenous daughter-cysts are present, the mother-cyst is, as a rule, of very large size, and contains as many as two or three thousand daughter-cysts varying in size from a pea to an orange. Occasionally, we find in echinococcus cysts occurring in cattle, that daughter-cysts are formed from the cuticle and protrude beyond the *external* wall of the parent-cyst. and form brood-capsules. A few examples of this condition have been reported in the human subject.

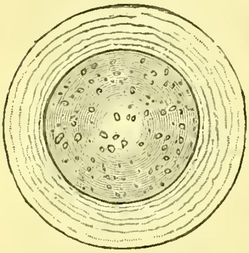

Fig. 38.—Hydatid of four weeks' growth, showing ectocyst and endocyst. × 60. After Leuckart.

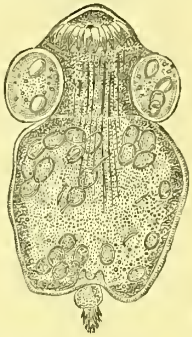

Fig. 39.—The so-called *Echinococcus head*, showing hooks, suckers, cilia, and corpuscles. × 250 diam. After Huxley.

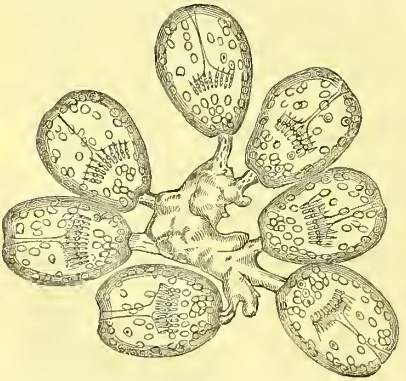

Fig. 40.—Group of Echinococci, with their hook-crowns inverted. × 180 diam. After Busk.

Echinococcus multilocularis is a variety of hydatid, which has been described as affecting the liver. It forms a hard tumour made up of alveoli, separated by fibrous tissue. The alveoli are filled with gelatinous transparent material, stained at times with bile. Such specimens were formerly described as colloid cancer of the liver, until Virchow pointed out that they were composed of echinococcus cysts, and occasionally contained scolices. Nearly all the reported cases have occurred in South Germany and Switzerland. The true nature of this form requires elucidation. The recognition of *E. multilocularis* is rendered more difficult by the circumstance that they sometimes ulcerate. This condition may easily be confounded with actinomycosis of the liver.

Anatomical Characters in Man.—The human body frequently contains echinococcus cysts; there is scarcely an organ in which it has not been found, even in the medullary cavities of bones. Like the *cysticercus cellulosæ*, the embryo of *T. echinococcus* has its favourite situations: the former selects chiefly the intermuscular connective tissue and brain, the latter selects mainly the viscera, especially the liver. The liability of organs to entertain hydatids may be inferred from Neisser's tables as quoted by Leuckart. They are based upon an analysis of 986 cases: Liver, 451; lungs and pleura, 84; kidney, 80; brain, 68; muscles, dermis, and orbit, 72; spinal cord, 13; pelvis, 36; circulatory organs, 29; spleen and bones, 28, and so on. This table is only useful as showing the greater liability of viscera to harbour this parasite. In the bones, eye, orbit, mamma, thyroid body, and heart it is of extremely rare occurrence.

It is strange that, though the liver is such a favourite viscus for hydatids, it is rare to find more than one cyst present in this organ at the same time in the human subject; yet in swine they are frequently multiple. In man, one large cyst may be lodged in the liver, and twenty, thirty, or even a hundred occupy the omentum, mesentery, &c. This condition is, however, very uncommon.

SYMPTOMS.—The danger caused by these cysts arises mainly from the mechanical pressure they exercise on surrounding parts. Thus, in the brain or heart, a cyst the size of a hazel-nut gives rise to serious disturbance, but one as large as a man's head is often tolerated in the liver or pelvis. These cysts are often found *post mortem* when their presence had never been suspected during life, although they attained goodly proportions. The parasite may die early in its career, and the cyst-wall calcify; hydatid membranes seem very prone to this change, the calcareous matter resembling very old dried mortar. Hydatid cysts cause death in a variety of ways. In the brain they simulate cerebral tumour, and induce death early, especially when growing near the bulb. In the spinal cord they produce paraplegia. In the liver they may be accidentally ruptured, and cause death in a few hours from shock and hæmorrhage combined, or, later, from peritonitis. In some instances, after injury or meddlesome tapping, suppuration takes place with septic troubles, which the formation of pus entails. Liver cysts may perforate the diaphragm, and rupture into the pleura, or communicate with the lung and its bronchi. Occasionally they open into stomach or bowel, the scolices being discharged *per anum.* They have been known to rupture into the bile-passages, the transit of the scolices causing biliary colic. Among the rarer sites of rupture may be mentioned the pericardium, vena cava inferior, or through the parietes of abdomen or thorax.

In the lung pressure upon the air-cells or bronchi may cause gangrene and other troubles which follow bronchial obstruction. Hydatid cysts of the thyroid body are very rare; they usually rupture into the trachea and cause death by suffocation.

DIAGNOSIS.—The diagnosis of hydatid cysts, in organs other than the liver, is attended with very great difficulty; and as these cysts frequently appear at *post-mortem* examinations and astonish the physicians, so are they one of the most fertile sources of surprise to enterprising surgeons. In the liver a hydatid cyst may be suspected when a tumour can be made out unaccompanied by pain, cachexia, high temperature, or wasting.

The conditions most likely to be confounded with hydatid cysts in the liver are abscess, distended gall-bladder, effusion in the right pleura, aneurysm of the abdominal aorta or hepatic artery, cancer of the liver, renal cysts, dilated stomach, pancreatic cyst, ovarian tumours, and dropsy due to closure of Winslow's foramen. *See* LIVER, Hydatid Disease of.

It is not wise to rely on the fact that the patient has lived among dogs or in a pastoral country. Individuals who have never kept or lived with dogs often develop hydatids.

When an abdominal or thoracic tumour is suspected to be a hydatid cyst (these are the situations in which physicians are most frequently called upon to diagnose them), the nature of the swelling should be ascertained by puncturing it with a trocar, and drawing off some of the fluid. The characters which determine its echinococcus nature are the following:—

The fluid is limpid, colourless (occasionally bile-stained when growing in the liver), and in specific gravity varies from 1009 to 1015. Free from albumen, it contains chloride of sodium, and is said to furnish traces of succinic acid, leucin and tyrosin. The three last are present in quantities too small to be of any clinical value. The most positive signs are the presence of brood-capsules, scolices, hooklets, or the gelatinous, trembling, laminated membrane which forms the true wall of the cyst, and is in itself absolutely peculiar to hydatids.

It must also be remembered that hydatid cysts are occasionally sterile—that is, they contain no brood-capsules and furnish no hooklets. Such cysts frequently attain a large size, and seem to occur most frequently in the pelvis; they are as a rule mistaken for other forms of cysts.

TREATMENT.—The treatment of hydatid cysts is entirely surgical. In such an organ as the liver the cyst should be freely opened, and its edges stitched to the sides of the incision and drained. The walls collapse, the cyst-membrane comes away during the operation, or is subsequently discharged piecemeal. The cavity then slowly granulates.

When hydatids are lodged in the omentum they are easily removed by abdominal section. When deeply placed in the pelvis they may be situated between the bladder and the rectum in the male, or burrow between the layers of the broad ligament in the female. These are better treated by incision and drainage. Hydatid cysts have many times been recorded in the kidney, but it is very unusual for them to exceed the dimensions of an orange. They exhibit a marked tendency to discharge into the renal pelvis, the vesicles escaping by way of the urethra. Should the cyst attain such proportions as to give rise to a palpable tumour, it should be explored by a lumbar incision, and treated in the way recommended for the liver. Such cysts arising in the kidney have been known to open into the lung, into the stomach, or communicate with the intestine. Intra-thoracic hydatids are best treated on the same surgical lines as empyema. In the subcutaneous tissues and orbit they are rarely diagnosed—indeed, these cysts in such situations can only be suspected; the suspicion is confirmed when the vesicles or portions of membranes escape during removal of the tumour. Intracranial hydatids have in Sydney, Australia, been successfully submitted to surgical procedure. It is certain that no tumour or cyst connected with the brain offers a more favourable prospect to surgeons than a hydatid cyst connected with the cerebral cortex.

II. Trematoda, or Flukes (τρῆμα, a hole).—Fr. *Trématodes*; Ger. *Trematoden*; *Saugwürmer*.—These forms have only one opening to the digestive cavity.

Varieties :—
a. Distoma hepaticum.
b. Distoma lanceolatum.
c. Distoma hæmatobium vel *Bilharzia hæmatobia.*
d. Distoma Ringeri.—*See* p. 259.

a., *b.* The first two are rarely seen, though they are common enough in the biliary passages of sheep and oxen. They are vulgarly known as flukes, and are the cause of the destructive disease known as 'the rot' of sheep. When flukes, with the exception of the *Bilharzia hæmatobia*, occur in man, they occupy the biliary passages, but are usually present in such limited number as to rarely cause any serious disturbance of health.

c. Bilharzia hæmatobia, or *Distoma hæmatobium*, unlike other forms of flukes, has the sexes distinct. The male is 12–14 mm. long, and has a flattened body, which, at its posterior part, is rolled into a kind of tube, constituting the gynæcophoric canal. The female is almost cylindrical in form, and 16–19 mm. long, being lodged within the gynæcophoric canal (fig. 41). The mature worms live in the inferior vena cava, portal, splenic, mesenteric, vesical, and hæmorrhoidal veins of men and monkeys. The ova pass into the mucous membrane of the bladder and intestine, probably escaping as a consequence of the rupture of small vessels. Occasionally the ova may be found in the ureter and the pelvis of the kidney. The ova, often present in great numbers, are furnished with either a terminal or a lateral spine. Dr. Zancarol says that ova with a lateral spine occur in the intestine; those with the terminal spine in the mucous membrane of the bladder. The use of this appendage has not yet been satisfactorily explained (fig. 42).

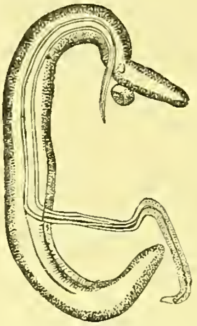
Fig. 41.—*Bilharzia hæmatobia,* male and female sexually combined. Magnified. After Küchenmeister.

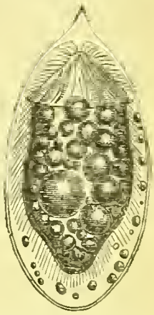
Fig. 42.—Ovum of *Bilharzia hæmatobia* with contained embryo and free sarcode-granules. × 234 diam. Original.

The *Bilharzia* is common in Egypt, Abyssinia, the Cape, and Natal. The cercaria, as the larval forms are termed, abound in rivers and canals, and are especially common in the Nile. When taken into the alimentary canal the cercaria quickly work their way into the mucous membranes, gain access to blood-vessels (veins), and develop into mature flukes.

Symptoms.—When lodged in the intestines they give rise to dysentery; in the bladder and ureters, to cystitis, hæmaturia, and vesical calculus. The hæmorrhage caused by their presence in the genito-urinary tract is known as 'endemic hæmaturia.' The eggs, whilst still within their host, may develop ciliated embryos. The disease may be suspected when hæmaturia occurs in persons coming from countries where the *Bilharzia* abounds: the diagnosis is confirmed by finding under the microscope the ova embedded in fragments and shreds of mucous membrane passed with the urine.

Treatment.—Means must be taken to allay the vesical irritation by such remedies as buchu, uva ursi, hyoscyamus, and the like. No remedy is known that acts as a parasiticide to the *Bilharzia*. It is wise to remove the patient, if possible, from an infected locality. Cure is likely to be protracted, and as yet we are ignorant of the duration of life of the fluke.

III. Nematoda, or Round-worms (νῆμα, a thread).—Fr. *Nématoïdes*; Ger. *Fadenwürmer.*

Varieties :—
a. Ascaris lumbricoides.
b. Oxyuris vermicularis.
c. Trichocephalus dispar.
d. Ankylostoma duodenale.
e. Filaria medinensis.
f. Trichina spiralis.
g. Filaria sanguinis hominis.

Most of these inhabit the alimentary canal, and when restricted to this region rarely give rise to dangerous symptoms, unless they be very numerous; but they are apt to migrate and invade other organs, and thus give rise to dangerous and often disastrous results.

a. Ascaris lumbricoides.—This, the common round or maw-worm, is of cylindrical shape, pointed at each end, and of a light brown colour. The female, as is usual among nematodes, exceeds the male in size. The length of the female varies from 25 to 40 cm. The male is distinguished by the presence of two chitinous spines near the caudal end of the body (fig. 43). This extremity is also bent and hook-like. The spines indicate the male genital orifice. In the female the genital pore is situated near the middle of the body. The ova are very numerous; when mature they possess a double shell surrounded by an albuminous coating, have considerable power of resistance, and are not killed by drying or freezing.

The life-history of the worm is not fully known, and we are ignorant of its intermediate host. Dr. Cobbold was of opinion that it did not require one, but that the eggs develop in water.

This worm lives chiefly in the small intestine, but may wander into the stomach, and even pass up the œsophagus and be discharged through the mouth. An *ascaris* has been known to creep into the bile-duct and cause jaundice. In cases of perforation of the intestine in fatal cases of typhoid fever, these worms have been found lodged in the aperture. We must not conclude from this that the worm caused the perforation; it is more reasonable to believe that when the accident happened the ascaris was passively lodged in the opening during the outward rush of the fluid contents of the bowel. It is possible that worms may occasionally perforate the intestinal wall, and, getting into the subserous tissue, give rise to abscess. Such cases have been recorded. The wandering habit of ascarides is often fatal to them. Any foreign body in the intestine is sure to attract their attention and to form a sort of 'worm-trap.' Thus they have been strangled by metallic buttons, hooks and eyes, open-topped thimbles and the like (Cobbold).

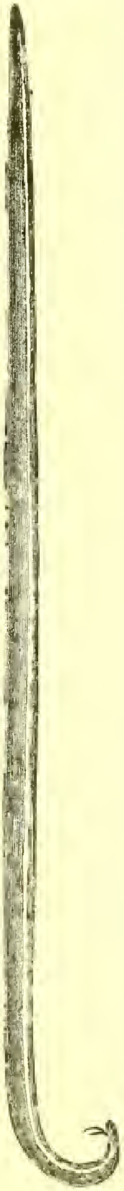

Fig. 43.—*Ascaris lumbricoides*; male, with exserted spicules. Nat. size (Cobbold).

Symptoms.—It is unusual for an individual to harbour more than two or three round worms, and as a rule they rarely give rise to symptoms. When present in large numbers—a condition of things most common in children—diarrhœa, colic, nausea, vomiting, and convulsions may occur. Children have been known to pass in the course of a few years one hundred worms, and in one case 510 worms were voided by a child. Generally the passage of a worm by the anus or mouth is the first and only indication of its presence.

Treatment.—The most reliable drug is santonin, in the form of a powder: for children two to four grains, followed by a saline purge or castor oil; for adults five grains daily; for three days each dose to be followed by castor oil. Among other useful remedies we may mention aloes, scammony, jalap, calomel, kamala, sulphur, and turpentine.

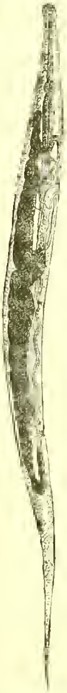

Fig. 44.—*Oxyuris vermicularis*, female. Highly magnified. After Leuckart.

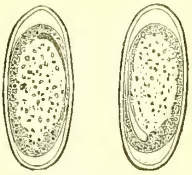

Fig. 45.—Eggs of *Oxyuris vermicularis*, enclosing tadpole-shaped embryos. × 450 diam. Original.

b. Oxyuris vermicularis (*Thread-* or *Seat-worm*).—The thread-worm is an inhabitant of the colon and adjacent parts of the ileum. The female is usually about 10 mm. and the male 4 mm. long. In addition to its greater size the female has a sharp-pointed tail, whereas in the male it is blunt and furnished with a spiculum (fig. 44). Some helminthologists are of opinion that the mature females inhabit the colon, whilst the males and immature females are found in the ileum.

Oxyurides are often present in large numbers, and wander into the rectum. They often cause intense irritation in the neighbourhood of the anus, and in females cause great distress by creeping into the genital passages, especially during the night. The eggs of *oxyuris* are expelled with the fæces and require to be taken into the stomach before they re-develop (fig. 45). Persons re-infect themselves by scratching the anus, and conveying the ova, by means of the finger-nails, to the mouth.

Symptoms.—Among the local symptoms heat and irritation around the anus and nose are common. In children especially we often find restlessness, nervous irritation, choreic symptoms, and convulsions. Signs suggesting such severe conditions as meningitis are by no means infrequent. The existence of thread-worms is easily verified by administering a mild purgative and examining the fæces. As a rule, they will be found in considerable numbers. In the case of children the attention of the nurse is called by finding the worms on the sheets.

Treatment.—Brisk saline purgatives to expel the worms, and extreme cleanliness to prevent re-infection, are usually all that is required. Fruits and vegetables should be thoroughly cooked. In adults treatment requires to be carried out more vigorously, with such drugs as calomel, scammony, aloes, jalap, santonin, and asafœtida, in conjunction with enemata of infusion of quassia, or salt and water.

c. *Trichocephalus dispar*, or *Whip-worm.*—The male and female equal each other in length; as a rule they average 4 to 5 mm. The anterior part of these worms is fine and thread-like, the posterior is thicker, and contains the genital organs. In the male the caudal end is rolled into a spiral; near the extremity it is furnished with a spine (fig. 46).

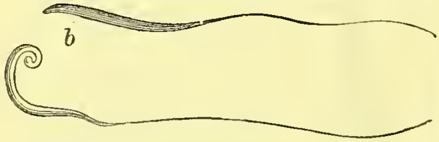

Fig. 46.—*Trichocephalus*; male (*a*), and female (*b*). Enlarged one-fourth.

The trichocephalus resides mainly in the cæcum. The early stages are passed in water or damp earth. The worm is very common in France: Davaine calculated that half the Parisians are infested by it. In England it is rare. Unless present in great quantities it is not often a source of trouble.

d. *Ankylostoma duodenale.*—This small worm is also known as *Sclerostoma duodenale*, *Dochmius*, or *Strongylus duodenalis.* Occasionally it is referred to as the *tunnel-worm*, on account of the disasters it caused among the men engaged in the Mount St. Gothard Tunnel. The female averages twelve mm. in length, the male is slightly smaller. The cephalic end is furnished with an oral capsule, which possesses a cleft covered by two chitinous lamellæ. The ventral lip has four curved teeth; the dorsal, two straight ones. The caudal end in the male has a three-lobed bursa and two spines (fig. 47). This worm infests the small intestine and bores its way into the mucous membrane. The effects of ankylostoma on the gut are very characteristic. The damaged spot is indicated by a small ecchymosis, with a central depressed white spot, in which the head of the worm lodged; occasionally it may be found still anchored to the mucous membrane. When present in large numbers these worms produce anæmia, sometimes called Egyptian chlorosis. The ankylostoma is very common in Egypt and Brazil. One stage of the worm is passed in muddy or dirty water; it gains access to the alimentary canal in drinking-water, and there attains its maturity.

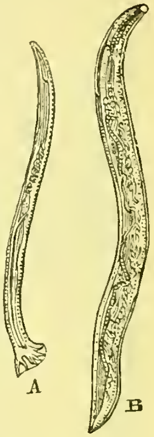

Fig. 47.—*Ankylo stoma duodenale*; male (A), and female (B). × 5 diam.

Symptoms.—The presence of this worm is indicated by the usual signs of anæmia, viz. pallor of the mucous membranes, weakness. palpitation, and faintness. Diarrhœa and dropsical effusions sometimes occur. The anæmia is due to the loss of blood consequent on the injuries inflicted by these parasites on the intestinal mucous membrane.

Treatment.—The worms should be evacuated by calomel and santonin combined, given at intervals over a period of a few weeks, for it must not be imagined that one or two doses will destroy the thousands of helminths lodged in the intestines in a severe example of this disease. The liquid extract of male fern is a useful remedy. The patient will require nourishing diet, easily digestible food, and good wine, with the usual tonic remedies.

e. *Filaria medinensis*, *Dracunculus*, or *Guinea-worm.*—This is a fine thread-like worm from 60 to 100 cm. in length, and about 2 mm. broad. The female only is known. The embryos develop within the uterus. The intermediate host is a minute crustacean (Cyclops), which inhabits drinking-water. Within the cyclops they are introduced into the human stomach, and then migrate into the subcutaneous tissues, where they become mature. A common situation is the tissue beneath the skin of the legs and feet; the heel is a favourite situation.

Fig. 48.—*Filaria medinensis.* Reduced to ½.

The worm is confined to certain districts of Asia, Africa, and Brazil. It is supposed to be identical with the fiery serpents mentioned in the Pentateuch.

When the worm first lodges in the subcutaneous tissue it gives rise to little trouble; as it grows an abscess forms and gradually exposes the worm. Treatment consists in carefully winding tho worm with gentle traction around a slender stick of ivory, bone, or wood, an inch or so daily, taking care not to break it. This method seems to have been employed of old by Persian surgeons.

f. Trichina spiralis.—The mature worm inhabits the intestinal canal. The female is 3 mm. long; the male is much smaller, and is further distinguished by presenting on the dorsal side of the tail two mammillary protuberances, which are turned towards the ventral aspect, and include between them four wart-like nodules (fig. 49). The young are developed in the uterus, and are born in a free state. The immature trichina inhabits voluntary muscular fibre, where it is usually coiled into a spiral, embedded in granular tissue and surrounded by a cyst-wall, which frequently contains calcareous particles (fig. 50). These capsules are visible to the naked eye as minute white specks. Each capsule usually contains one trichina, but two, three, and even five may be present.

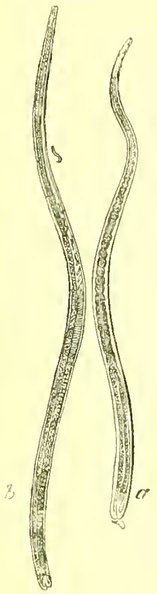

FIG. 49.—*Trichina spiralis* magnified; male (*a*), and female (*b*). After Leuckart.

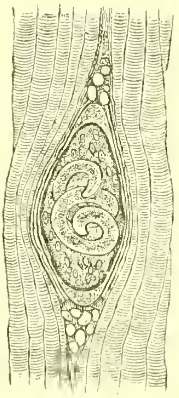

FIG. 50.—Portion of human muscle, enclosing a single capsuled *trichina*. Highly magnified. After Leuckart.

The relation of the two forms is as follows. When a piece of muscle containing living trichinæ is taken into the stomach, the capsules are digested and the worms set free. In two days and a half they become mature, and pair. The embryos commence to be born on the seventh day; and the female may continue to bring forth worms for many days. The mature worm lives but a few weeks, but during this brief life may bring forth a thousand or thirteen hundred embryos. The young then seek for striated muscle-fibre, and migrate through the wall of the intestine and the subperitoneal tissue. A few may get into vessels and are distributed by the circulation. On gaining access to a muscle they penetrate the fasciculi, becoming in about fourteen days mature muscle-trichinæ. In due course they become encysted; the cyst is said to be in part due to a secretion furnished by the trichina. After a time the cyst-wall calcifies; should the trichina die, the cyst-contents also calcify. The duration of life of the worm in the muscle is very long, and even survives for a time the death of its host. The trichinæ are found most abundantly in the intercostal muscles, diaphragm, and laryngeal muscles. In the limb muscles they are less abundant, and cluster near the union of the muscle with its tendon. The trichinæ so accurately select the voluntary muscles that the pharyngeal constrictors and upper part of the œsophagus will lodge hundreds of them, while the rest of the tube contains none.

SYMPTOMS.—Human beings usually acquire the disease from eating trichinosed pork. The symptoms may be divided into two stages: the first consists of gastro-intestinal disturbance due to the introduction of the parasite; the second corresponds to the migration of the worm, and is characterised by muscular troubles and febrile disturbance.

The gravity of the symptoms depends upon the number of trichinæ taken. The initial gastro-intestinal catarrh lasts usually about a week. The second stage is characterised by high fever and pain in the limbs and muscles, often mistaken for rheumatism. The muscles sometimes swell, become œdematous, and occasionally are partially paralysed. In grave cases delirium ensues, the limbs become flexed and paralysed, there is excessive diarrhœa, terminating in death. The duration of the second stage lasts four or five weeks. In fatal cases, death usually occurs about the third or fourth week.

At the end of five weeks the migration is usually complete, and the trichinæ once encysted give rise to no further trouble. That this is so is clear from the fact that, in dissecting-rooms. subjects occasionally occur with many hundred thousand trichinæ encysted in the voluntary muscles of all parts of the body, from the head to the sole of the foot. The diagnosis may sometimes be established during life by an examination of suspected articles of food, or by the detection of adult trichinæ in the evacuations during the course of the disease. The most certain plan is to remove a fragment of affected muscle and examine it under the microscope.

Treatment.—If it can be at once ascertained that trichinosed food has been taken into the stomach, an emetic should be administered without delay, followed by a brisk purgative; this treatment should be pursued for several days to expel the worms before they become mature. Calomel alone, or combined with scammony or jalap, is recommended. Even when the young filariæ have begun their migrations, brisk cathartics still do good; but the patient's strength will require support during this critical stage by solutions of meat, broth, eggs, milk, and the judicious administration of wine or brandy. As the patient becomes convalescent ordinary tonics will be needed.

Preventive treatment consists in rejecting suspected trichinosed food, especially pork. The disease is rare in Great Britain, but fairly frequent in Germany, where it is the custom to eat 'Wurst,' or sausages made of smoked ham.

g. Filaria sanguinis hominis.—This parasite and its embryo are separately described. *See* Filaria Sanguinis Hominis.

IV. **Gregarinidæ** (*gregarius*, from *grex*, a flock).—Fr. *Grégarines*; Ger. *Gregarinen.*

Variety:—*Coccidium oviforme.*

The disease produced by the presence of the *coccidium oviforme* is known as *Psorospermia* (*ψώρα* or *ψώρη*, a cutaneous disease—the itch, scab, or mange. The Latin equivalent is *scabies*). The French use the word *psore* as a generic title for vesicular and pustular maladies of the skin. J. Müller seems to have first used the word 'psorosperm' to indicate a parasitic affection of the skin, gills, muscles, and kidneys of fish and frogs. In the skin of fish the disease consisted of small sacs containing oval bodies, some with and some without tails; these he termed psorosperm saccules.

It has long been known that the destructive liver-disease of rabbits is due to the presence of small oval bodies named *coccidia oviformia*, lodged in the bile-ducts. The coccidium is thus described by Leuckart: It is egg-shaped, 0·033 to 0·37 mm. long, and 0·015 to 0·02 mm. wide, with a thick smooth shell, possessing at one end, usually the narrower, a micropyle. The coccidia resemble very closely the eggs of certain entozoa.

It has been known since 1858 that this coccidium occurs in the human subject, and since that date numerous cases have been observed. Among the recent cases, one described by Mr. Silcock may be mentioned. A woman, fifty-three years of age, was thought to be suffering from typhoid fever. The illness dated from a chill taken seven weeks before death. The symptoms were pain in the limbs, nausea, and occasional sickness, tenderness over the liver and spleen, fever of remittent type, the temperature reaching 103° F., and slight diarrhœa. The urine was albuminous, the splenic and hepatic dulness increased, and the tongue dry and coated with brown fur. Death resulted from cardiac failure.

On *post-mortem* examination the liver weighed eighty-three ounces, and contained numerous small caseous foci; the spleen weighed sixteen ounces, and presented similar foci varying in size from a pin's head to a pea. Papule-like elevations dotted the mucous membrane of the ileum and large intestine. The naked-eye characters of these nodules resembled tubercle, but on microscopic examination they were found to be coccidium nodules.

The mucous membrane of the ureters is a favourite situation for these nodules. In this situation they give rise to hæmaturia, frequent micturition, and death from exhaustion.

There is reason to believe that these parasites invade the orifices of the follicular ducts of the skin and give rise to molluscum contagiosum and chronic eczema of the nipple (Darier). Confirmatory observations have been made in London.

V. **Rhizopoda** (*ῥίζα*, a root; and *ποῦς*, a foot).—Fr. *Rhizopodes*; Ger. *Rhizopoden.*

Amœba coli.—Lambl appears to have been the first to detect amœbæ as human parasites, but the first satisfactory investigations were made by Lösch in 1875. He found them in the stools of a Russian peasant suffering from ulceration of the large intestine. In this case the amœbæ were five to eight times larger than the red blood-corpuscles; their protoplasm, which was coarsely granular, presented a few blunt processes, a round nucleus, and several vacuoles.

Lösch found them in great number; as many as sixty could be seen in one field of view with a magnifying power of 500. The peasant who was the subject of Lösch's researches had lived a miserable life; his illness presented all the signs of violent dysentery. Pleurisy and pneumonia supervened, accompanied by anæmia, exhaustion, and death. The fresh dejections from this patient were injected into dogs *per os et anum*, but with incomplete results. In 1883 Kartulis examined in Egypt 150 bodies of persons dead of dysentery, and found the amœba in every case. In twelve *post-mortem* examinations amœbæ were found in the ulcers. Subsequently Kartulis extended his observations to hepatic abscess complicating dysentery, and found amœbæ in sections of the abscess-wall. They resembled those found in the intestine. He has since extended his researches so as to include 500 cases of dysentery, with confirmatory results.

The amœba coli has been found in the intestines of dysenteric patients by other observers—Massentin, Baumgarten, and Osler.

Dr. Osler's observations were made on a doctor, twenty-nine years of age, resident in Panama for nearly six years, who had suffered from chronic dysentery. When he came under Dr. Osler's care, abscess of the liver was detected and drained. As the pus came from the drainage-tube, samples were taken at once to the laboratory and examined. Amœbæ were present in large numbers, and continued to be present until the patient died. Amœbæ were also found in the stools, and in every respect identical with those from the abscess. They were rarely found in the brownish stools, but were more frequent in the mucus and in the greyish fragments of sloughs.

The amœbæ in size ranged from 10–20 mm., and were somewhat larger than those found by Kartulis. When once recognised there was not the slightest difficulty in distinguishing them, even when at rest, from pus-cells, not merely by their size, but from the entirely different appearance of their protoplasm.

How far these bodies are the exciting agents of the disease is uncertain, because amœbæ have been found in normal fæces; nevertheless they are deserving of extended study. They have been found in Egypt, Athens, St. Petersburg, London, and America.

J. Bland Sutton.

ENTOZOON FOLLICULORUM.—A synonym of the animalcule of the follicles of the skin, otherwise named acarus (Simon), demodex (Owen), and steatozoon folliculorum (Erasmus Wilson). *See* Acarus.

ENTROPION (ἐν, in; and τρέπω, I turn). A morbid condition in which the eyelid is inverted, so that its free margin is directed towards the eye. *See* Eye and its Appendages, Diseases of.

ENURESIS (ἐν, in; and οὐρέω, I pass the urine).—Involuntary discharge or incontinence of urine. *See* Micturition, Disorders of.

EPHELIS. — Synon.: Sunburn; Fr. *Ephelide*; Ger. *Sonnenflecken.*—This word is applied to pigmentary discoloration of the skin, of a brown, grey, or black colour, increased by the stimulus of light and heat, as of the sun's rays, or scorching by fire. Two principal varieties of the affection have been noted, namely, Ephelis solaris, and Ephelis ignealis. *See* Pigmentary Skin-Diseases.

Erasmus Wilson.

EPHEMERAL FEVER (ἐπί, upon; and ἡμέρα, a day).—A mild form of milk-fever, so called on account of the rapidity with which it subsides, lasting not more than a day. *See* Milk-Fever.

EPHIDROSIS (ἐπί, upon; and ἱδρόω, I sweat).—A term signifying a state of sweating, and synonymous with idrosis. *See* Perspiration, Disorders of.

EPIDEMIC (*epidemicus*, affecting the people; from ἐπί, upon; and δῆμος, a people).

The word 'epidemic' is used in two senses by medical writers and by medical men, namely, (1) in a general sense, and (2) in a technical sense.

As a *general term* the word signifies 'common to, or affecting, a whole people, or a great number in a community; prevalent; general' (*Webster's Dictionary*). It is in this sense that the word is used when it is applied to mental, moral, and social phenomena, as, for example, when we speak or write of 'epidemic suicide,' 'epidemic folly.' This employment of the word is consistent with received literary practice. Thus we read, 'There was a time when *wit was epidemic*' (*Athenæum*). Again, M. Littré, writing to the *Temps*: 'It argues great confidence in oneself and one's own enlightenment to treat with haughty disdain, and without reserving any compromise, the opinion of so many citizens, and to regard it as a case of *epidemic aberration*.'

As a *technical term*, having reference to disease, the word 'epidemic' has several different meanings attached to it. All these meanings include the notion of general prevalence among a community or a people, but some of them would go on, beyond what etymology justifies, to attach a peculiar hypothetical or theoretical conception to the term. Thus (*a*) Mayne restricts the term to diseases which are contagious, making contagion the essence of *epidemicity*, as he would phrase it; (*b*) Dunglison implies by the term a particular constitution of the air ('*constitutio aeris*, or condition of the atmosphere'); (*c*) other authoritative writers use the term as signifying a widespread cause, telluric, atmospheric, cosmic, as the case may be, acting at the same moment of time on many individuals, or as something occult, regarding which speculation is vain, and which they designate *epidemic constitution* or *epidemic influence*.

The foregoing technical significations attached to the word 'epidemic' are not less misleading than insufficient. Mayne's definition imposes an arbitrary limitation upon the meaning of the word, while it involves but a partial notion of the phenomena of epidemic prevalence of contagious diseases. Dunglison's definition does not rest upon a scientific foundation, and its phraseology, derived from a period when medicine was still hampered with semi-mystical speculations, cannot well be dispossessed of the vague traditional meanings which adhere to the word 'constitution.' Other technical definitions (if that can be called a definition which makes obscure what should be rendered clear) rest on mere assumptions, or relegate the term to the incomprehensible and insoluble. Of these last-named definitions Léon Colin has said: 'They signify implicitly a common cause, apparently indecomposable, to which individuals are not exposed successively but simultaneously . . . a something isolated, impersonal, inaccessible to reason, detached from the disease itself, the epidemic genius [constitution, influence] . . . a creative force of the different epidemic affections, compelling, directing, extinguishing them.'

The promiscuous use of the word 'epidemic' in medical literature and medical talk, and the different irreconcilable significations attached to it as a technical term, have been, and still continue to be, sources of almost hopeless confusion in treating of diseases in respect to which the phenomenon of (etymologically) epidemic prevalence is observed. It is not difficult to apprehend how this has come about. The diseases in question (the *morbi populares* of some writers) include among their number plague, the eruptive and continued fevers, influenza, malignant cholera, &c. 'They have the peculiar character of attacking at intervals great numbers of people within a short period of time; they distinguish one country from another, one year from another; they have proved epochs in chronology; and, as Niebuhr has shown, have influenced not only the fate of cities, such as Athens and Florence, but of empires; they decimate armies, disable fleets; they take the lives of criminals that justice has not condemned; they redouble the dangers of crowded hospitals; they infest the habitations of the poor, and strike the artisan in his strength down from comfort into helpless poverty; they carry away the infant from the mother's breast, and the old man at the end of life; but their direst eruptions are excessively fatal to men in the prime and vigour of age' (Wm. Farr). Exercising at all times in their greater and more fatal prevalence the profoundest influence over the mind, as well of the people generally as of the medical profession, these diseases, partly from the terror they inspire, partly from the extreme complexity of the phenomena they display, have formed a never-ceasing subject of the wildest speculation. No part of medicine has retained so much of the semi-mystical teachings of the older physicians as that which relates to epidemics, and general history has contributed with medical history to propagate in regard to epidemics that habit of thought which refers the unknown to the occult—using the latter term in the sense in which it is applied with regard to the imaginary sciences of the Middle Ages. Much of the speculation as to epidemics which passes current for science at the present day is in reality an unsuspected continuation of the mystical teachings of earlier medicine—magnetism, or electricity, for example, taking the place of Saturn or Mercury in the scheme of causation. The terminology is modernised, but the underlying conception remains the same. Again, the so-called '*precursors*' of epidemics, which still find a place in treatises on medicine, are the relics of the doctrine of portents of the Middle Ages. They rest on the assumption of an epidemic being determined by some common extra-mundane or intra-mundane cause, of which it is but one of several effects. The celestial 'portents,' such as comets and meteors, and the more manifest telluric 'portents,' such as earthquakes and volcanic eruptions, have been discarded; but the 'portents' derived from exceptional developments of insect life, from murrain, from unusual prevalence of certain diseases, and from remarkable perturbations of the weather, are retained under the denomination of 'precursors.' For example, the earlier epidemics of malignant cholera which visited Europe were believed to have been heralded by an unusual prevalence of 'fevers' and of diarrhœal affections. The epidemic of 1865–66 gave an excellent opportunity of studying the facts bearing on this question. Europe was taken by surprise when cholera appeared in 1865, on the south coast of the Mediterranean, at Alexandria, and began thence to extend rapidly to the southern and eastern shores of that sea. It was not, indeed, until the disease had effected a lodgment in several parts of the Continent that the attention of governments and the public with regard to it was fully aroused. No change of the public health in the several places visited by the epidemic had occurred of such a nature as to give rise to any, even the least, suspicion of impending pestilence. Moreover, notwithstanding the prevalence of steppe-murrain and of cerebro-spinal fever in Northern Europe at the beginning of 1865, there was nothing to suggest (indeed it was not suggested) that these phenomena were 'precursors' of the coming epidemic of cholera, or of the extension of yellow fever to the shores of England the same year. In fact, the different occurrences were parts of contemporaneous rather than successive phenomena. The condition of the public health preceding the appearance of cholera in England, and especially in respect to diarrhœa antecedents, was made the subject of careful study by the late Professor Parkes and others. These observers failed to obtain any inkling of a change in the public health which could be regarded as presaging pestilence—of the existence, in short, of any so-called 'epidemic constitution.' It is true that John Sutherland had described an increase of 'fevers' and diarrhœal disease in Malta, as preceding the appearance of cholera there, in June 1865, observing that: 'These facts are sufficient to show that, long before cholera began to come towards the north-west, there were indications of a changed condition of the public health in Malta;' and after giving an account of two groups of choleraic cases which occurred in May, he adds, 'It appears to me scarcely possible to escape from the conclusion that, long before cholera appeared in Malta, possibly before the first outbreak in Arabia, the earliest wave of the coming epidemic had passed over those islands.' But while, according to Dr. Sutherland, the coming epidemic was thus clearly foreshadowed in Malta, no change in the public health presaged its appearance in Gibraltar in July. The absence of all foreshadowing of the epidemic at Gibraltar can hardly be reconciled with the suggested presence of such foreshadowing at Malta. The facts which have been interpreted as presaging the appearance of cholera in the latter island are, indeed, to be regarded as coincidental rather than related. It is true, also, that MM. Didiot and Gués have endeavoured to show that, prior to the appearance of cholera at Alexandria in 1865, choleraic disease existed in Marseilles, and that the outbreak of the epidemic in the latter town was preceded by 'une constitution médicale cholérique.' The evidence they advance in support of their conclusions simply shows that deaths from infantile cholera, which, as they properly remark, is, 'à la vérité, fréquente à Marseille,' and from so-called 'sporadic' cholera, are apt to occur in Marseilles during the months of May and June, as perhaps in every city and town of Southern and Central Europe.

Another illustration to the same effect as the above, in regard to the 'precursors' of epidemics, is furnished by the history of the small-pox epidemic of 1869–73, the greatest epidemic of this disease in recent times—a true pandemic (πάνδημος, from πᾶν, all; and δῆμος, the people) extension of the malady. The acutest observers were taken by surprise with the malignity and diffusibility of the disease during the epidemic—phenomena wholly unforeseen. Here, again, the study of the diseases preceding or accompanying the epidemic yields no facts of variation in their prevalence, from which the approach of a great epidemic might have been inferred, nor gives any hint that they were dependent with it on some common cause.

There were *concurrent* phenomena of disease during both epidemics, but they were concurrences of certain diseases existing at the same time among the population affected by the great epidemic, and some of them probably having certain secondary elements of causation in common. This is a different question to that of an assumed 'epidemic influence' or 'epidemic constitution.' The subject of the *concurrence of epidemics* is a new field of investigation, which has lately been opened by an arithmetical study of George Buchanan's, relating to epidemics in numerous extra-metropolitan registration sub-districts in England. This study was directed to ascertain—as necessarily introductory to a statistical investigation regarding community of causation or mutual antagonism of various epidemics—the arithmetical probability of their concurring as a mere matter of chance. The data used were taken from a particular quarterly return of the Registrar-General, and they extended to 946 occurrences of epidemics (small-pox, measles, scarlet-fever, diphtheria, whooping-cough, fevers, and diarrhœa and simple cholera) in 1,490 districts. The result showed a good deal of general correspondence between the calculated number of concurrences and the actually observed number, but with departures, of more or less magnitude, of the actual from the calculated degree of concurrence, which deserve to be followed up by further investigation. The departures were shown in an excessive frequency of the concurrence of measles with the other epidemics, of diarrhœa with all other epidemics except small-pox, and of scarlet-fever with the 'fever' of the Registrar-General. On the other hand, it is of interest to observe that there was an absence of any notable excess of frequency of concurrence between scarlet-fever and diphtheria, or between scarlet-fever and whooping-cough.

In view of the extreme looseness with which the word 'epidemic' is used in medicine, sometimes simply as a descriptive term, sometimes as a technical or quasi-technical term involving various hypothetical and theoretical conceptions inconsistent with each other, and sometimes as implying an occult influence, it would be well if it could be discarded from medical literature and language. 'Epidemic,' in its present medical uses, is an instance of words which, as Bacon says, when writing of the effects exercised by a bad and inapt formation of words on the human mind, 'force the understanding, throw everything into confusion, and lead mankind into vain and innumerable controversies' (*Nov. Org.* App. 43). But the retention of the word, from its long and familiar usage, is practically a necessity in medicine; moreover, it would be difficult, if not impossible, to find a substitute which, if the word be used in its ordinary signification, would supply its place.

It is suggested here that the technical meaning of the word 'epidemic' should be assimilated to the common meaning; or, more accurately, that the technical meanings now attached to the word should be abandoned, and the word used in medicine in the same sense as in general literature and in ordinary converse; that is to say, as a merely quantitative term applicable to particular phenomena, whether pathological, mental, or social, in so far as they are 'common to a whole people, or to a great number in a community,' or, in a word, are 'prevalent' or 'general.' In this way not only would the confusion arising from the present medical uses of the word be got rid of, but the scientific study of epidemic phenomena would be facilitated in the only direction which gives promise of successful issue. As Léon Colin has aptly written: 'It is the disease which constitutes the epidemic, not the epidemic the disease. The evil always remains the same, the number of affected alone being increased.' The medical study of epidemics is essentially a study of the individual diseases which are apt to become epidemic, and not, as has been too commonly the case hitherto, of some figment of the imagination (*epidemic constitution*, or *influence*, or *genius*), apart from the diseases. It is only in proportion as researches have been directed to particular diseases liable to become epidemic, and to the conditions under which they prevailed epidemically, that recent advances in our knowledge of epidemics have been made. In this country the two most important events which have occurred in this connexion of late years were the discrimination of *typhus* from *typhoid fever*, by A. P. Stewart and William Jenner, and the researches on the *typhus of horned cattle* (steppe-murrain, *cattle-plague*) promoted by the Royal Commission of 1865–66 on Cattle-Plague. The discrimination of typhus from typhoid fever proved that the voluminous speculations which to that time were current on the epidemiology of the continued fevers of this country, then regarded as but *one* disease presenting several varieties, were for the most part meaningless verbiage, by showing that the two most common forms of fever were distinct diseases, clinically, pathologically, and ætiologically. This discovery proved to be the inauguration of a true method of investigation concerning epidemics, by making evident that epidemic phenomena did not admit of accurate study, except in so far as it was based upon a just discrimination of the diseases manifesting them, and upon their clinical and pathological histories. The same lesson was taught, not less clearly, although in another fashion, by the researches promoted by the Royal Commission on Cattle-Plague, with which the names of Lionel Beale and Burdon Sanderson are especially connected. These researches demonstrated the essentially infectious nature of the malady, and that its prevalence was dependent upon the dissemination of the infection, directly or indirectly, from animals sick of the disease to the healthy. It was shown, indeed, in the pathological laboratory, that preconceived doctrines of some occult epidemic influence which had been submitted to the Commission as determining the prevalence of the cattle-plague had no existence in fact when the disease was subjected to experimental study, and that its conditions of prevalence were fully within human control. These researches proved the starting-point of those important investigations on the intimate pathology of contagion carried out by Burdon Sanderson and Klein, for the Privy Council, under the direction of John Simon, and to which William Roberts and others have independently contributed so largely, and which have been followed by the investigations into the intimate pathology of scarlatina and diphtheria by Klein acting under the instructions of George Buchanan for the Local Government Board. *See* also Periodicity in Disease.

J. Netten Radcliffe. Shirley F. Murphy.

EPIDEMIC CEREBRO-SPINAL MENINGITIS.—A synonym for cerebro-spinal fever. *See* Cerebro-spinal Fever.

EPIDEMICS, Occurrence of.—*See* Periodicity in Disease.

EPIDERMIS, Diseases of.—*See* Skin, Diseases of.

EPIDERMOPHYTON (ἐπί, upon; δέρμα, the skin; and φυτόν, a plant).—The name of the epiphyte, or parasitic fungus, of pityriasis versicolor; also called microsporon. *See* Epiphyta.

EPIDIDYMITIS (ἐπί, upon; and δίδυμος, a testicle).—Inflammation of the epididymis. *See* Testes, Diseases of.

EPIGASTRIC REGION.—This region is situated at the upper and central part of the abdomen, just below the ensiform cartilage, and between the sloping margins of the thorax down to the level of the ninth cartilage, corresponding to what is popularly known as the 'pit of the stomach.' The structures within the abdominal cavity which normally occupy the epigastrium are the greater part of the stomach, a small portion of the liver, and more deeply a part of the pancreas, the aorta giving off the cœliac axis and superior mesenteric branch, the vena cava inferior, the veins forming the commencement of the portal vein, the receptaculum chyli, and the solar plexus.

Clinical Investigation.—Clinically, it will be found that patients frequently complain of abnormal sensations specially referred to the epigastrium. These are generally associated with the stomach, and may merely amount to a sense of discomfort, fulness, or tightness; or to actual pain of varying character, more or less severe according to the condition upon which it depends, and often much influenced by the ingestion of food. Sensations of trembling, throbbing, or sinking at the pit of the stomach are also of common occurrence, especially in females. These are often merely of a nervous character. In some cases there is evident tenderness, either over the entire epigastrium or in some limited spot, and it is important to recognise whether this is superficial or felt more or less deeply, for it may be connected with the superficial structures, the peritoneum, the liver, the stomach, or the pancreas. The sensation experienced in connexion with hunger is referred mainly to the epigastrium, and it may be of a painful character. Here may also be noticed the epigastric pain termed *gastralgia* or *gastrodynia*, which is usually felt chiefly when the stomach is empty, being relieved by taking food. A most unpleasant sensation at the pit of the stomach accompanies nausea, which may be of a horrible but indescribable character; while violent vomiting or retching causes considerable pain or aching in this region, partly associated with the stomach, partly with the abdominal walls. Heartburn is another sensation which seems to start from the epigastrium. Sometimes the pain is situated deeply, or shoots towards the back. This may depend upon disease affecting the posterior wall of the stomach, pancreatic disease, aneurysm, or other causes. A sensation of tension or actual pain is sometimes experienced just below the ensiform cartilage in cases where the diaphragm is much pressed downwards, as from extreme emphysema, abundant accumulation of fluid or air in the pleura, or extensive pericardial effusion. A deep pain is not uncommonly referred to the epigastrium in cases of Addison's disease, and also in those of pernicious anæmia. Probably this is connected with the sympathetic plexuses.

Physical examination of the epigastric region is often of the greatest value, and important objective signs of various morbid conditions may thus be readily recognised. Of course organs which normally occupy other regions may enlarge so as to extend into the epigastrium, or may become very movable and consequently be felt in this region. It may, moreover, be occupied, along with other parts of the abdomen, by growths or accumulations of fluid. The objective signs and conditions which are more especially connected with the epigastrium may be indicated as follows:—

1. It is customary to apply the hand over the epigastrium for the purpose of counting the respirations, if these cannot be reckoned by merely watching the patient breathing.

2. Morbid conditions of the abdominal walls may be confined to the epigastric region, such as an abscess; and here it may be remarked that the recti muscles frequently become very hard and rigid when palpation is practised over this part, and so might be in danger of being mistaken for some serious lesion, unless care were exercised in the examination.

3. Growths connected with the peritoneum, especially the great omentum, may be felt chiefly or entirely in the epigastrium in some instances.

4. Abnormal states of the stomach are necessarily revealed mainly by corresponding signs in the epigastrium. Thus there may be evidence of dilatation of this organ; of carcinomatous infiltration or thickening of its anterior wall; of a localised tumour; or of some accumulation in its interior, whether solid or liquid. It must be remarked, however, that the stomach, when diseased, frequently extends into other regions beyond the epigastrium, or is actually displaced.

5. When the liver is the seat of organic disease, this is often revealed in the epigastric region, usually along with other regions, but sometimes the abnormal physical signs are noticed specially in this part. Thus a cancerous mass may present here, or a hydatid tumour or hepatic abscess may tend in this direction. The gall-bladder has also occasionally been found, when the seat of some accumulation or of malignant disease, to have been displaced towards the epigastrium and become fixed there.

6. Pulsation is not uncommonly felt in the epigastrium. When situated at its upper part, just below the ensiform cartilage, it depends upon the heart, usually its right side, being due either to shortness of the sternum, displacement of the heart, or enlargement of its right cavities. Very often a pulsation is felt, and sometimes even seen, due to a pulsating aorta, especially in thin and anæmic subjects; and an impulse from this vessel may be transmitted through an enlarged pancreas, or through an abscess of the liver, of which the writer has seen a marked example. Occasionally an impulse in the epigastrium is connected with an aneurysm, either of the aorta or of one of its branches. A pulsation in this region has also been attributed to regurgitation of blood from the right auricle into the inferior vena cava and hepatic veins, in cases of tricuspid incompetency. A murmur may sometimes be heard in the epigastrium. Usually this is a conducted cardiac murmur, but occasionally it depends on an aneurysm.

Frederick T. Roberts.

EPIGLOTTIS, Diseases of.—*See* Larynx, Diseases of.

EPILEPSY (ἐπιλαμβάνω, I seize upon).—Synon.: *Morbus comitialis, sacer, major, &c.*; Fr. *Épilepsie, haut mal, &c.*; Ger. *Fallsucht.*

Definition.—In its common form this apyretic affection is a neurosis, characterised by seizures of loss of consciousness, with tonic or clonic convulsions. When either of these manifestations recurs in fits, epilepsy exists, although incomplete, as shown by the following facts: first, that patients who generally have convulsions only are sometimes seized also with unconsciousness; secondly, that others who usually have seizures of loss of consciousness, without marked spasmodic action, sometimes have complete fits of epilepsy.

Some writers confine the name of *Epilepsy* to the well-defined form of that neurosis known as *idiopathic*. Others consider as belonging to epilepsy most of, if not all, the non-febrile affections recurring in fits, and of which we sometimes have good instances in cases of paroxysmal aphasia, amaurosis, paralysis, or involuntary movements, either disordered or well co-ordinated, &c. There is no doubt that all apyretic nervous affections, appearing in seizures, have, on account of this special feature, a common link with epilepsy. In this article, however, the writer will only study the ordinary forms of the *morbus comitialis* and the epileptiform manifestations due to brain-disease.

ÆTIOLOGY.—Under this head we will study, first, what relates to the *causation of the morbid state* in which epilepsy essentially consists; secondly the *causes of attacks.*

Predisposing Causes.—Heredity deserves to be noticed first, not because it is the most frequent, but because it is a most undeniable cause. Pritchard has shown that all neuroses have the greatest relationship one to another. It is but natural, therefore, that epileptics are very often found to have had a father or a mother who suffered from some kind of nervous disorder. Moreau has shown that epileptics are often the offspring of insane parents. It is quite certain that people attacked either with organic disease of the brain, and having had no convulsions, or with any kind of neurosis or any form of insanity, very frequently have children who become epileptic. Important statistical data, given by Féré, show that, among the direct ascendants of 594 epileptics, 70 had suffered from epilepsy, 166 from insanity, 88 from paralysis, 21 from general paralysis, 72 from hysteria, 73 from senile dementia, 33 from puerperal eclampsia, 61 from chorea. The number of cases of nervous disorders among the direct ascendants of those 594 epileptics was 1,024. Inherited epilepsy, according to the writer's experience, which agrees with that of Féré, chiefly appears between the ages of 12 and 18; but its percentage remains high up to the age of 40, as, according to Dr. Gowers, out of 235 epileptics from 20 to 39 years old, 80 had inherited this affection, which gives 34 per cent. This shows how erroneous is the view of some able physicians, who maintain that after the age of 20 inherited epilepsy is not to be dreaded. It is certain, however, that this inheritance becomes relatively extremely rare in advanced life. But it can yet show itself at the ages of 70 (Poilroux) and 71 (Dr. Gowers). Still, we strongly advise that symptoms of an organic disease, and especially of a cerebral tumour, be most carefully sought for in all cases of supposed inherited idiopathic epilepsy in patients over 50.

The power of *alcoholism* in parents is so great that, out of the 594 epileptics studied by Féré, 258 had parents addicted to habits of hard drinking.

As regards the influence of *sex*, there is a marked difference between men and women of somewhat advanced age, the proportion of epileptic females being then larger than that of males; but for people under 25 years of age the reverse is true.

Independently of sex, *age* has certainly a decided influence on the appearance of epilepsy. The following table, borrowed from Hasse and Dr. Gowers, is important, as the results are grounded on most extensive statistical data. These results agree fully with the writer's own observations.

Age at commencement	No. attacked	
	Hasse	Gowers
Under 10	393	422
11 to 20	364	665
21 to 30	111	224
31 to 40	59	87
41 to 50	51	31
51 to 60	13	16
61 to 70	4	4
At 71	0	1
	995	1,450

The writer's experience seems to show that hereditary epilepsy makes its appearance chiefly between 10 and 12 in both sexes. At any rate it is certain that inheritance manifests itself rather before than during the period of change that puberty causes. Romberg, Dr. Russell Reynolds, and others have already pointed out that such is the general rule.

Puberty itself is a cause of epilepsy. This is clearly proved by the large number of epileptics who, as shown in the preceding table, have been attacked between the ages of 10 and 20 (364 out of 995, and 665 out of 1,450).

Of other causes, the most powerful are perhaps not those usually stated. In patients under 15 years of age the most frequent cause, after heredity, is some obscure alteration of nutrition of the brain, or congestion of that organ or of its membranes, lasting a more or less considerable time after typhoid fever or scarlatina. It is frequent, indeed, that in examining such patients (even when there are reasons to believe in heredity) there are a number of symptoms showing some deficiency in the action of the brain, as regards its motor, sensitive, or sensorial functions. It is most important to detect these symptoms, as the form of epilepsy due to or allied with the cerebral alteration then existing is often curable, or at least can be considerably benefited by treatment.

Alterations of *blood*, in quantity or quality, often contribute to the production of epilepsy. But, however true it is that a rapid and considerable loss of blood can cause an epileptiform attack, it has not been shown that such a cause has ever produced a lasting epilepsy. It is nevertheless well known that anæmia is a very frequent factor in the causation of that neurosis or of any other. A weak and slow action of the heart also is found in a number of cases to be among the causes of epilepsy (Sir W. Burnett, Blondeau). But the reverse is sometimes observed; and, according to the writer's practice, cases of epilepsy are not very rare in which the pulse was strong and beating more than 90 or 100 times a minute, without any organic affection that could account for this phenomenon. In these cases the only morbid condition that could be looked upon as a cause of epilepsy was the abnormal circulation, which may be remediable.

There is no doubt that, when epilepsy appears in cases of Bright's disease, of affections of the liver or other viscera, it is due, at least in most cases, to the presence of some toxic agent in the blood; but other ætiological factors exist sometimes. Among them one especially deserves attention—it is an irritation of the nerves of the diseased viscus.

Secondary syphilis is a frequent cause of epilepsy. Undoubtedly syphilis then acts chiefly through the alterations it produces in the brain and meninges; but it often acts also on the cranial periosteum, and in disturbing nutrition and sanguification.

Of other dyscrasiæ *gout* has very little power; but *rheumatism*, although not frequently, can cause epilepsy by its morbid influences on the brain and its membranes, and by the production of diseases of the heart and the great blood-vessels.

Diabetes has been classed among affections sometimes causing epilepsy, but the question is then whether it is the presence of sugar in the blood or some affection of the medulla oblongata which brings on this affection.

Oxide of carbon, carbonic acid, lead, absinthe, alcohol, and a number of other *toxic agents* have sometimes produced a lasting epilepsy. Asphyxia by strangulation was in one case the cause of epilepsy (A. Beardsley).

Purely *psychical* or emotional causes have much less power than has been supposed. But their influence is great in bringing on attacks when epilepsy exists.

Determining Causes.—The most frequent causes of epilepsy, however, are not the preceding, which generally are only predisposing circumstances. The really active efficient causes of epileptiform convulsions, and even sometimes of genuine and complete *morbus comitialis*, are to be found in the four following groups of organic morbid states: (1) Lesions of some parts of the *brain*; (2) morbid conditions of the *meninges* or of the periosteum of the cranium; (3) lesions of the *spinal cord* or its membranes; (4) *peripheric* lesions anywhere. It is only for convenience sake that the writer establishes these divisions, as he looks upon all the four groups as quite alike. In neither of the four kinds of cases is the location of the lesion the seat of the neurosis, that place being only the seat of an irritative cause. Each of these kinds of causes will now be studied, the first one only with some development.

1. *Lesions of the brain considered as causes of epilepsy.*—This subject must be subdivided as follows: (*a*) parts of the brain that give rise to that affection; (*b*) kinds of brain-lesion which bring on that neurosis.

(*a*) What are the *parts* of the brain which can produce epilepsy? Facts answer that all parts have that power, as will be proved hereafter. On account of the importance of this subject as regards diagnosis and therapeutics of the nervous centres, the writer has noted down for more than twenty years all that relates to convulsions out of many thousands of cases of cerebral disease. Unfortunately, for a long time not having counted the cases without convulsions, he cannot say out of how many cases of brain disease come the 1,688 cases of convulsions he has collected.

The first important result of these researches is that partial or unilateral convulsions are more frequent than bilateral or general convulsions. Out of the 1,688 cases there are 887 in which the convulsions were altogether limited to one or two limbs, or began in one side before reaching the other, or were more violent in one side than in the other; while the number of general convulsions was 801.

The 887 cases of unilateral convulsions can be classified as follows:—

Side of Convulsions		Side of Lesion
Right	102	Right
Left	90	Left
Right	294	Left
Left	247	Right
Right	73	Two sides
Left	81	Two sides

As seen in this table, there were 192 cases of direct and 541 of crossed convulsions, with 154 cases of unilateral convulsions due to lesion in the two sides.

Of the 801 cases of convulsions in both sides of the body, there were 525 due to a unilateral lesion and 276 caused by a lesion in the two sides of the brain. In the 525 cases, the lesion in 235 was in the right side, and in 290 it was in the left.

It is remarkable that, contrary to what was long believed by the writer and other authors, the number of cases of convulsions (partial or general) due to a lesion in the right side of the brain is notably less frequent than that of cases of lesion in the left, as shown in this table:—

Side of Lesion		Convulsions
Right	Left	
235	290	Two-sided
247	294	Crossed
102	90	Direct
584	674	

It is very remarkable also that convulsions do not take place much more frequently on the right side of the body than on the left, the numbers being for the right 469 cases, for the left 418 cases.

As regards the parts of the brain where a lesion is found, it is not possible to make use of all the facts, because, when a lesion is in the two sides, it very rarely occupies similar parts in both; and also in a rather large proportion of cases the lesion occupied two or more parts of the brain. The following table gives the number of cases for lesions in all the important parts of the encephalon:—

1. So-called motor centres	196	cases
2. Cortex cerebri out of the motor zone	173	„
3. Surface or internal parts frontal lobe	144	„
4. „ „ „ parietal „	140	„
5. Base of the brain	91	„
6. Surface or internal parts of occipital lobe	89	„
7. Cerebellum	57	„
8. Surface or internal parts sph. temp. lobe	54	„
9. Centrum ovale	52	„
10. Optic thalamus	42	„
11. Corp. str., opt. thal. & internal capsule	25	„
12. Corpus striatum	24	„
13. Lateral ventricle	21	„
14. Cornu Ammonis	7	„
	1,115	„

It is essential to remark that the number of cases of lesion of the cortex cerebri in the so-called motor zone or out of it (369 out of 1,115 cases—*i.e.* about 33 per cent.) is possibly greater than it should have been, owing to the probable co-existence, in some cases, of a meningeal affection with the lesion of the brain-tissue. The writer must say that he has eliminated as completely as he could from the cases he has collected of disease of the cerebral surface those in which there was a complication of meningitis. If we add to these 369 cases one-half of those of disease of the four cerebral lobes (214 out of 427)—which ought to be done, because in more than one-half of these last cases the surface was partly the seat of the lesion—there are 583 cases of convulsions from disease of the cortex cerebri (583 out of 1,115—*i.e.* about 52 per cent.) The cerebral convolutions have more power than the rest of the brain to give rise to convulsions, but the cortex, outside of the so-called motor zone, has at least as much power as that zone.

Concerning the parts of the brain considered as not motor, we find that there are 89 cases of lesion of the occipital lobe and 54 of the spheno-temporal lobe, giving a total of 143 cases; to which we have to add the 173 cases of superficial lesion out of the motor zone; so that there are 316 cases of convulsion from a lesion in parts which, according to many authorities, ought not to have produced such a symptom. In more than one-half of the cases of disease of the cerebellum there was no pressure on the base of the brain, so that we could add a good many of the 57 cases of lesion of that nervous centre to the 316 cases above mentioned.

It would be wrong to imagine that, because the number of cases of convulsions was much larger when disease existed in the parietal lobe (140 cases), that that part has more power to originate epileptiform contractions than the occipital lobe (89 cases). The reverse is true, because, in opposition to all that is taught on this point, this last lobe has more power than the parietal in that respect (if we leave aside what relates to the ascending parietal). This can easily be proved. The number of cases of organic disease (especially hæmorrhage, as one can see in Gintrac's great work containing 127 cases of hæmorrhage in the parietal lobe and only 33 in the occipital) of the parietal lobe is more than treble that of cases of lesion of the occipital; while the number of cases of convulsions due to disease of the first of these parts not only is not three times as large as that of cases of convulsions due to the occipital lobe, but is even far from being the double. This last part, therefore, although supposed not to be motor, has more influence than the parietal lobe in giving rise to epileptiform convulsions.

Taking into account the frequency of disease in the four cerebral lobes, the number of cases of lesions which in each of them generate convulsions, shows that the frontal lobe is the one which has the greatest influence as regards the production of epileptiform convulsions. Next to it comes the occipital lobe, and, after these two lobes, we have to place almost on a similar level the parietal and the temporo-sphenoidal lobes.

Considering the frequency of disease, and especially of hæmorrhage, in the corpus striatum, which has been supposed to have a great influence in producing epileptiform convulsions, it is remarkable that that part of the brain has given rise to convulsions only 25 times (hardly more than 2 per cent.) The percentage given by the optic thalamus in that respect is higher (3·6 per cent.)

All the internal parts of the brain (centrum ovale, the lateral ventricles, and the central ganglia) give only 164 cases (15 per cent.), not much more than the frontal lobe (144 cases, almost 13 per cent.), although the central parts of the cerebrum are far more frequently diseased than the anterior lobe.

(*b*) There is certainly a very great difference between the various *kinds* of disease of or injury to the brain with regard to their power of giving rise to genuine epilepsy or to epileptiform convulsions. Still, it is very difficult to draw positive conclusions out of what has been published on this point, because the subject has not been studied as it should have been. Certain parts of the brain will give rise to convulsions, while others will not, under one and the same kind of lesion; but a part like the frontal lobe, for instance, which will so often generate genuine epilepsy or epileptiform convulsions under causes such as an injury, a tumour, an abscess, or an inflammatory softening, will rarely produce convulsions under a cause which is an injury, but of a peculiar kind—*i.e.* a hæmorrhage. In other parts, on the contrary, a hæmorrhage will most frequently give origin to convulsions. The following table, from data furnished by Gintrac, is interesting in that respect; it shows what has been the frequency of convulsions in cases of hæmorrhage:—

Cases of hæmorrhage			Cases of convulsions
43	in	cortex cerebri	11
127	„	parietal lobe	25
33	„	occipital „	7
17	„	frontal „	2
38	„	optic thalamus	20
72	„	corpus striatum	0
48	„	both central ganglia	5
46	„	lateral ventricles	14
56	„	cerebellum	10
70	„	pons Varolii	25
5	„	crus cerebri	2
555			121

It is a most remarkable fact that out of 38 cases of hæmorrhage in the optic thalamus there were convulsions in 20—*i.e.* more than one-half of the cases; while there were none in any of the 72 cases of hæmorrhage in the corpus striatum. It is perhaps more remarkable that when both ganglia were the seat of the effusion of blood there were only 5 cases of convulsions out of 48 of hæmorrhage.

Tumour and tubercle are, with hæmorrhages and inflammatory softening, the lesions of the brain which give rise most frequently to partial or general convulsions. While tumours of the frontal lobe produce epilepsy or epileptiform convulsions in more than two-thirds of the cases, tumours of the temporo-sphenoidal lobe give rise to convulsions in about one-half, and tumours of the parietal and the occipital lobes in only about one-third of the cases. A remarkable fact which comes out of the study of cases of tumour of the brain published by Ladame, Bernhardt, Gintrac, and others, is that the base of the brain under the irritation of tumours gives rise to convulsions very much less frequently than the surface of the brain. Indeed, one part of the brain—the medulla oblongata—did not originate convulsions in one single instance out of 21 cases of tumour published by Bernhardt. This kind of disease of the medulla oblongata is not, however, incapable of giving rise to epileptiform attacks, as the writer knows of five cases of tumour of that organ causing convulsions.

There is no kind of lesion which may not give origin to convulsions. But there is one species of tumour, namely, aneurysm, which causes convulsions considerably less frequently than any other. Out of 86 cases of aneurysm of the various encephalic arteries, given by Gintrac, there were convulsions only in three, if we put aside, as ought to be done, the cases in which there were alterations in brain-tissue or a rupture of the aneurysmal sac.

Abscesses of the brain have more influence in the causation of epileptiform convulsions than is generally admitted. Out of 87 cases of unilateral abscess collected by the writer, convulsions occurred in 43 cases.

Unilateral atrophy of the brain, of a very old date as regards its origin, is known to be allied not rarely to epilepsy (partial or general). Summing up 78 cases given by Cotard, Boyd, Turner, and Gintrac, the writer finds that epileptiform convulsions or genuine epilepsy existed in 20 cases. It is of great importance against the views of those who try to locate epilepsy in the so-called motor centres, that not only those parts were absolutely destroyed in more than one-half of those 20 cases, but that the so-called motor track in the brain and spinal cord was deeply altered if not destroyed, at least in certain parts of its length, and that nevertheless convulsions occurred, either anywhere, or chiefly or exclusively in the paralysed limbs.

Softening due to embolism causes convulsions almost as often as inflammatory softening, except when the seat of the lesion is the cortex cerebri. White softening of vessels of the occipital and of the frontal lobes produces convulsions more frequently than the same lesion in the parietal lobe. Embolism without any marked softening very rarely produces convulsions.

All kinds of entozoa in the brain very frequently give rise to convulsions, but none so often as cysticerci, if Kuchenmeister is right. He states that out of 30 cases of cysticerci in the encephalon there were 24 cases with convulsions. No other cause of irritation, whatever be its seat in the brain, originates convulsions so often as that.

The application of a ligature on one of the carotid arteries has brought on convulsions in a number of instances; and, what is remarkable, when the convulsions were unilateral they appeared on the corresponding side in more cases than on the opposite side.

2. *Lesions of the meninges considered as causes of epilepsy.*—The reader may refer to the articles on the Diseases of the Meninges and Diseases of the Cranium for what relates to convulsions due to these morbid states. Complete and persistent epilepsy due to chronic meningitis is very rare; but syphilitic affections either of the dura mater or of the periosteum of the cranium not very rarely will give rise to this affection. *See* MENINGES, CEREBRAL, Diseases of; and SKULL, Diseases and Deformities of.

3. *Lesions of the spinal cord considered as causes of epilepsy.*—In the writer's work on Epilepsy he has shown that this affection can arise from disease of the spinal cord. Since 1857, when that work appeared, many facts have come to his knowledge establishing that his conclusion was right. He only

maintained—and he does not now go beyond that assertion—that epilepsy sometimes has its cause in the spinal cord.

4. *Peripheric lesions.*—That genuine epilepsy can have its cause in any part of the body is now a recognised truth. But, besides that form of the *morbus comitialis*, what may be called the cerebral form, consisting in unilateral convulsions, can be originated by an irritation of either a nerve or a viscus. Among the parts of the body having the greatest power with regard to the production of epileptiform convulsions, we may name the bowels, the trigeminal and the sciatic nerves, the abdominal sympathetic nerve, and the sexual organs. Indigestible food may be the cause of an attack. In countries chiefly inhabited by the Anglo-Saxon race, children of the two sexes being less watched and less warned than elsewhere against the dangers of onanism, epilepsy due to this fatal habit is particularly frequent.

The great importance of a thorough knowledge of certain symptoms of cerebral epilepsy, especially as regards surgical treatment, makes it necessary that these symptoms should be carefully studied. It must be first stated that every kind of organic brain disease, wherever situated, may cause any form of epilepsy, and that, on the other hand, every form of this neurosis may exist without any cerebral organic affection. To this must be added that any part of the brain may be the seat of any kind of disease without convulsions appearing anywhere. In more than two thousand cases of brain disease analysed by the writer for other purposes, there were no convulsions. Out of that number there were more than one hundred cases of simply irritative lesion of the so-called motor centres, limited to them or invading the neighbouring parts, in which there were various symptoms, but no convulsions. In more than 160 cases of disease (destructive and irritative, or simply irritative) of the base of the brain there were no convulsions. Simply irritative lesions of the so-called motor tract, the internal capsule, between the great cerebral ganglia, did not cause convulsions in more than 45 cases. The part which gives the smallest number of cases without convulsions is the optic thalamus, and the part most able to bear any kind of irritation without producing convulsions is the corpus striatum.

These *negative* facts show as well as the *positive* ones—*i.e.* those in which convulsions take place—that that symptom appears or not according only to the excitability of certain parts of the nervous centres in different individuals. This result is borne out also by the study of unilateral convulsions, as is shown by an analysis of 887 cases collected by the writer.

The conclusions to be drawn from the study of these cases can be summed up as follows: (1) These convulsions can be produced by a lesion in almost any part of the brain; (2) they can be caused by any kind of lesion; (3) they can begin in any muscle or group of muscles, or simultaneously in every part of one-half of the body (eye, face, neck, trunk, and limbs); (4) they can be preceded by any kind of aura, local or general; (5) they can be associated with any other symptom of brain disease, or be, for some time or till death, the only existing cerebral symptom; (6) they often precede general convulsions or appear at the end of such an attack; (7) they usually last longer than general convulsions even due to brain disease, but they especially last much longer than seizures of idiopathic epilepsy; (8) like other convulsions due to an encephalic affection, they often appear without loss of consciousness at the beginning or during the whole time they last; (9) they can take place either on the side of the brain-lesion that causes them or on the opposite side; (10) the proportion of cases of direct convulsions to cross ones, when the lesion is in the cerebrum, is about one to three, but the direct convulsions are more frequent than the cross ones, when that cause is in the base of the brain (crus cerebri, pons, and medulla); (11) the right limbs are more frequently attacked than the left (right 396 cases, left 337), and this rule is true for direct as well as for cross convulsions; (12) in the same individual, even when there is but one lesion, they can appear at first on the side of the lesion and afterwards on the opposite side, or *vice versâ*; (13) they can occur on the side where exists a cross hemiplegia or on the opposite side; but they can also be direct, the paralysis also being direct; or they can be cross, the paralysis being direct; (14) Jacksonian convulsions (either when exclusively and persistently unilateral or only temporarily so) can appear on the side of the lesion, or from a lesion in parts of the brain belonging neither to the so-called motor zone nor to the first and second frontal convolutions, which Dr. Hughlings Jackson now supposes to be psycho-motor.

On account of the importance of Jacksonian convulsions for surgical treatment, it must be said that, as stated in the last of the above conclusions, they may appear, as shown by a number of cases, on the side of the lesion. In a case of that kind the surgeon, by pressing on the dura-mater on the *right* side, increased convulsions of the *right* limbs (Leroy).

Many cases show that surgeons led by the views of localisers might make great mistakes. For instance, in a typical case of Dr. Hughlings Jackson's, instead of the toes it was a finger which was first convulsed, although the lesion was in the paracentral lobe; in a case of Andral's, Jacksonian convulsions limited to the right arm were caused by a tumour between the left posterior lobe and the cerebellum; in a case of Prof. Virchow, Jacksonian convulsions beginning in the left leg were due to a tumour of the right posterior lobe; in a celebrated case of Moreau (De Tours) there was a notable aura in the left hand and convulsions of the left arm due to a cyst in the anterior lobe near the right corpus striatum and the lateral ventricle. A good many facts show that Jacksonian convulsions, although caused generally by lesions of the first and second frontal or the two ascending convolutions, can be produced by lesions in many other parts of the brain very far from those convolutions.

Of the 887 cases of unilateral convulsions analysed by the writer, the arm or the leg alone, or one of these limbs at times, the other in other attacks, were the parts affected in 381 cases. The following table shows what parts of the brain were the seats of the lesion producing these partial convulsions.

	Arm	Leg	Leg or arm
Motor centres . . .	81	12	1
Surface frontal lobe . .	17	1	1
„ parietal lobe . .	13	1	2
„ sphen. temp. lobe .	8	1	0
„ occipital lobe .	12	1	0
„ several lobes . .	22	2	2
Almost whole hemisph. .	7	0	1
Frontal lobe . . .	16	1	0
Parietal lobe . . .	15	0	1
Sph. temp. lobe . .	9	0	0
Occipital lobe . . .	10	1	1
Centrum ovale . . .	20	1	0
Lateral ventricle . .	9	2	0
Two central ganglia . .	5	2	0
Optic thalamus . . .	8	4	1
Corpus striatum . .	4	2	1
Base of brain . . .	16	5	0
Cerebellum . . .	10	2	0
Several parts . . .	33	1	0
	315	39	11

This table shows that the so-called motor zone and the rest of the cerebral cortex gave rise to a very large proportion of convulsions of one limb alone. There were 153 cases of convulsions of the arm, 18 of the leg, and 6 of leg and arm alternately. It will also be seen that the base of the brain, if it gave a small proportion of cases of convulsions of the arm, gave a large one of convulsions of the leg. But the most remarkable point is that *all parts of the brain can give rise to convulsions of the arm, and that most parts can produce convulsions in the leg.*

Most important conclusions can be drawn from the study of the percentage of cases of convulsions of the arm in the number of cases of unilateral convulsions. Thus it can be easily ascertained that the percentage is enormous—82 per cent.—for cases with a lesion of the spheno-temporal lobe; it is also very large for cases of lesion of the surface of the occipital lobe (50 per cent.); of the spheno-temporal lobe (47·6 per cent.); and of the frontal lobe (45·9 per cent.) Next come the so-called motor centres (45 per cent.), the mass of the occipital lobe (40 per cent.), the centrum ovale (37·7 per cent.), the cerebellum (37 per cent.), the parietal lobe (35 per cent.), and the frontal lobe (33·3 per cent.) A lesion of almost the whole brain (19 per cent.) and of the base of the brain (23·8 per cent.) give the smallest percentages.

As regards the leg, the largest percentage is furnished by the cerebral ganglia, next to which come the base of the brain, the cerebellum, the surface of the spheno-temporal and occipital lobes, and the so-called motor centres. It is evident from the facts relating to the leg, but still more from those concerning the arm, that great mistakes in the diagnosis of the localisation of disease might be made if convulsions of the leg or arm were looked upon as a proof that the cerebral lesion causing them is located in the motor zone, even if we include in it, according to Dr. Hughlings Jackson's views, the two first frontal convolutions.

Convulsions from brain disease may be alternate—*i.e.* they may affect the limbs on one side and the face on the other—and this owing to a lesion of either one or both sides of the cerebrum or the base of the brain.

It is important to know that unilateral convulsions are sometimes due to a peripheric irritation (in the bowels, the liver, the kidney, &c.), without any kind of disease existing in the brain.

There is no doubt that convulsions of one arm are often associated with spasmodic movements of the face; but there is no doubt also that the most heterogeneous associations of partial convulsions are sometimes witnessed: convulsions in one leg and in one eye, of the thoracic muscles and the face or of the neck and legs, and a great many other associations, from lesions which cannot give the key of these singular facts. The two arms or the two legs are not rarely affected together, even under the influence of lesions of only one side of the brain.

The kind of association between paralysis and convulsions is most interesting. French surgeons, till a somewhat recent period, gave it as a law that when convulsions from brain disease occur without paralysis they show themselves on the opposite side to that of the cerebral lesion; but that when there is paralysis, this symptom appears on the side opposite to that of the lesion, and convulsions occur on the corresponding side. This is the reverse of what is seen in the great majority of cases, in which paralysis and convulsions coexist on the same side. But there are two kinds of cases in which the convulsions are on one side and paralysis on the other. The writer has collected more than 200 cases in which the convulsions were on the side of the lesion, and paralysis on the opposite side; and 16 cases in which the contrary existed—*i.e.* convulsions on the opposite, and paralysis on the corresponding side. Here also we have a proof of the great variety of effects that can come from an irritation of the same or of various parts of the brain.

Unilateral convulsions have no essential connexion with psycho-motor centres, as is proved by cases of lesion of those centres on one side causing that kind of convulsions sometimes in one side of the body, sometimes in the other. The writer has seen two such cases and collected 42 other cases, some from most able observers, including Dr. Hughlings Jackson.

Many cases of epilepsy in man are on record, resembling the special kind seen in certain animals, particularly in this respect, that an attack can easily be produced by a peripheric irritation. The writer has collected more than sixty such cases. They form two principal groups—one in which an irritation of almost any part of the body was able to give rise to an attack; the other in which certain parts only had that power. Many of those cases belonged to the class of organic cerebral epilepsy; some depended on diseases of the pericranium, of the spine or its contents, of nerves or of one of the thoracic or abdominal viscera; while in other cases there was a genuine idiopathic epilepsy. The parts of the body which are most frequently found giving rise to an attack, are the pit of the stomach (under the influence of even a very slight pressure) and the skin of the neck laterally from the lower jaw to the collar-bone.

Symptoms.—We shall consider this part of the subject under three heads—the *premonitory*, the *paroxysmal*, and the *inter-paroxysmal* symptoms.

1. Premonitory.—The frequency of premonitory symptoms, according to the writer's experience, is much greater than is generally known. It is extremely important to find out the existence of these warnings, as in many cases attacks may easily be prevented if we know when they are on the point of taking place. When we say that premonitory indications are extremely frequent, we do not mean that the classic or *Galenic aura* is often found. That vague, queer, and unexplained sensation, whether accompanied or not by a muscular contraction, is certainly more frequent than is admitted, but is considerably less frequent than the other kinds of warning. Among the premonitory symptoms there are four oftener observed than others: one is a change of temper (irascibility, appearing or increasing); another is a contraction of the vessels in the feet or hands, producing a diminution of temperature; and the two others are a spasmodic state of some muscle, or an optical illusion or hallucination. The following list mentions but a part of the various manifestations which indicate that an epileptic attack is threatening. Alterations of the various functions of the brain, sensations of any kind, headache or backache, vertigo, sensorial disturbances, sleeplessness or sleepiness, palpitation of the heart, dilatation or contraction of blood-vessels anywhere, altered breathing, diminution or increase of the various secretions (of the skin, mucous membranes, or of the visceral glands), hæmorrhages from the nostrils or other parts, fever, more or less marked weakness (general or local), hunger or thirst, disgust for food or drinks, an increase of the sexual appetite or the diminution or loss of sexual desire or power, spontaneous erection, and spasm of the bladder—sometimes accompanied by involuntary evacuations of urine—involuntary expulsion of fæces, cramps, trembling, choreic movements, tendency to run forwards, backwards, or round, rigidity or convulsions of a limb or other parts, paralysis of a limb or other parts—such is an abbreviated list of the forerunners noticed by a number of observers, and all of which the writer has seen or knows to have occurred in his patients.

Sometimes one or several of hese symptoms will appear a day or two before the attack, but generally the warning shows itself a few hours, or a very much shorter time (even only a few seconds or a minute or two), before the seizure. Not rarely in cases of epilepsy due to an organic cerebral disease, or to cerebral congestion, a drawing of the head towards one shoulder will take place either before or during an attack. Premonitory symptoms unfortunately may be deceptive, as they can appear without being followed by the attack; and even in cases in which warnings usually exist there are sometimes attacks without any forerunner.

2. Paroxysmal.—The paroxysmal symptoms vary considerably according to the kind of attack. If the fit is one of *petit mal* (*epilepsia mitior*), there may be no other symptom than a loss of consciousness, with either a fixed state of the muscles of the eye or a slight contraction of one or more muscles of the face or neck, or a movement of the lips, tongue, and throat, as in the act of swallowing. According to his personal observation, the writer is inclined to affirm than an attack of *petit mal* never consists in a loss of consciousness only—*i.e.* without the least trace of any other trouble whatsoever. Dr. Russell Reynolds, however, states that he has seen such attacks, and therefore we must admit that sometimes a pure and simple loss of perception and volition is all that exists in a seizure of epilepsia mitior. In such an attack the patient may, if walking, continue to walk; but, if talking, he stops—generally for so short a time, however, that the trouble may pass absolutely unnoticed by listeners. Such an attack usually lasts only from one to four or a few more seconds.

Haut Mal.—In a complete attack of epilepsy, an irritation proceeding from a moral or physical source is the cause of an act of inhibition of the mental activity, and of a reflex contraction of blood-vessels in the cerebral lobes. Loss of consciousness is, of course, the consequence of that inhibition. Together with Kussmaul and Tenner, the writer had long looked upon spasm of cerebral vessels as the cause of the loss of consciousness. He had a confirmation of that supposition in his epileptic guinea-pigs, in which he found that the blood-vessels of the brain contracted when consciousness disappeared. Since then, however, he has ascertained that consciousness was lost in the seizure, even after the excision of the upper cervical ganglia of the two sympathetic nerves—when, of course, the cerebral vessels remained dilated before, during, and after the fit—just as it is lost in animals having contraction of these vessels. Dr. W. Alexander has observed that in man, loss of consciousness in fits occurs after the excision of these ganglia, the same as before that operation. It is evident, therefore, that a spasm of the vessels of the brain is not an essential element in the causation of the loss of mental faculty. Still, when that spasm exists, and so long as it lasts, the lack of blood in the cerebral hemispheres must necessarily contribute to the cessation of the mental activity. The reasons for admitting that an act of inhibition is the first or principal cause of the loss of consciousness will be found in the writer's published papers on this subject.

Muscular spasms of a tonic character begin at the same moment that consciousness disappears. They may begin first in any part of the body, whether the attack is to be general, or to remain in one half of the body, or in one limb. Rather frequently the muscles of the face, the eyes, and the neck are seized before those of other parts, but the time is so very short between the appearance of spasm in these muscles and the general stiffness, that it is almost always very difficult to detect that these phenomena are not simultaneous. Together with the first appearance of a spasmodic condition in the face and neck there is also in a great many cases a contraction of some muscles of the larynx and of the expiratory muscles of the thorax and abdomen, producing the so-called epileptic *cry*, the character of which is so special that, when once heard, it can always be recognised even when the patient is not seen. When an epileptic is standing, at the onset of a complete attack, he falls. This is not due solely to loss of consciousness, as we know that in fits of *petit mal* this accident may not occur. The fall is sometimes an *active* one: the patient is precipitated more or less violently forward, backward, or laterally by muscular contractions. Then the fall may be either a *paralytic* or a *convulsive* one.

Generally a period of rigidity exists before the clonic convulsions appear. This stage of tonic spasm almost always lasts only a few seconds; but it may constitute the whole attack, and then it may last longer. On the contrary, clonic convulsions may appear at the onset of the seizure. In almost all cases, however, they follow a general stiffness, and form a second stage or period of the fit of which by their violence and duration they are the principal part. The clonic spasmodic contractions as a rule last hardly more than from one to three minutes in idiopathic cases.

When a fit lasts five, six, eight, or ten minutes, even if there be no sign of an organic disease of the brain, there is some reason to suspect that the attack is brought on by such a cause. Generally, in complete seizures, the limbs on the two sides of the body have similar convulsions, but in cases of brain-disease there may be clonic convulsions on the one side and tonic rigidity on the other. In the face, the eyes, the neck, differences between the sides are frequent, or at least not rare, even in idiopathic epilepsy. In most cases, the eyes are drawn up under the upper eyelid, and they roll from side to side. It is not rare that the eyes, face, and head turn convulsively towards the left or the right side, sometimes jerking, however, alternately from one to the other side. When the head is carried sideways—to the right, for instance—it is chiefly owing to a spasm of the left sterno-cleido-mastoideus, but also to the group of muscles of the top of the neck on the right side.

Breathing is considerably interfered with during the whole attack. After the spasmodic action of the expiratory muscles contributing to the shriek, there is almost always for a time (not longer usually than one or two seconds) a stoppage of respiration from the persistence of that initial spasm. During the whole fit respiration is convulsive, irregular, jerky, or gasping, and always incomplete. A real asphyxia, going as far as cyanosis, soon shows itself. The face, which was pale at the onset, becomes red, and promptly assumes a livid, dark, purple or bluish-violet hue. A frothy saliva, frequently of a reddish tinge, from effused blood coming from the biting of the tongue or lips, issues, little by little, from the mouth. It is extremely rare that the movements of the heart are modified at the onset; but palpitation, or a diminution (and even a complete inhibition) of the cardiac movements has been noticed by the writer in a few instances. Soon, however, the heart becomes very much excited and beats quickly, as in ordinary asphyxia. The temperature rises (1° or 2° F. and sometimes a little more); and the whole trunk, the face, and limbs, are covered with perspiration. The pupils always dilate considerably, sometimes after an evident contraction; the eyes are bloodshot; and hæmorrhage may occur there or in other parts, such as the nostrils, the ears, the bronchi, or even the capillaries of the skin or of the brain. Urine may be expelled from a spasm of the bladder at the onset, or from paralysis of the sphincter at the end of the fit.

As a rule, at the end of the convulsions the patient passes, without recovering consciousness, into a heavy sleep, with more or less violent stertorous breathing. A real comatose state is not rare. There is no doubt that these symptoms are more intense if no care be taken as regards the tongue and head. The patient should not be left on his back; and the tongue, which falls and covers the laryngeal opening, should be drawn forward. Some alleviation is almost always obtained when this is done for the tongue, and when the body, and especially the head, are placed on one side. Generally the sleep following a paroxysm does not last much more than an hour, sometimes not as long as that; but it is exceedingly rare that there is no sleep at all. The more violent the convulsions have been, the more there is relaxation of the muscles after they have ceased. When lifted up, the limbs may fall as if they were completely paralysed.

On waking from the sleep following a seizure most patients are very tired, the limbs and trunk aching, as well as the head. Usually there is some mental alteration, often consisting of confusion or stupor, and sometimes delirium. The mind, however, may be quite clear, even after a violent attack, and the head free from pain, the only effect of the fit being general lassitude. On the contrary, after an apparently slight seizure there is sometimes considerable mental disorder. The degree and duration of stupor after an attack have no relation to the duration of the convulsive period. Stupor is chiefly an effect of asphyxia, and is therefore in direct relation with laryngismus, trachelism, and the spasms of the thoracic muscles, of the diaphragm, and perhaps of the bronchial tubes also. It has been stated, and denied, that the urine passed after an attack of epilepsy sometimes contains albumen in patients free from kidney-disease. In at least five cases the writer has ascertained that there was a notable amount of albumen in the first issue of urine after attacks in which there had been violent spasmodic contractions of the abdominal and thoracic muscles. There was no disease of the kidneys or of the heart in those patients.

Attacks of epilepsy are sometimes very slight, consisting only, besides the loss of consciousness, of an extremely short tonic spasm of muscles of the trunk, the neck, the head, and the limbs. But even in the shortest and slightest attack of that kind the epileptic cry may be uttered, the tongue may be bitten, and there may be a somewhat comatose sleep after the fit.

It is now very well known that frequently there is after a fit a real paralysis, which sometimes persists for a long time. This loss of power is supposed to be the result of exhaustion from discharge of nerve-force, while it is evidently the effect of an act of inhibition associated with the convulsions—inhibition striking other motor elements than the excitation which causes convulsions. If it were an exhaustion from over-action the following facts could not exist: (1) the paralysis may appear after attacks which are not violent, and not show itself after most violent and prolonged convulsions; (2) there may be a paralysis in one or two limbs after an attack of *petit mal*, in which no convulsion has taken place in those parts; (3) after equal convulsions on the two sides of the body there may be a paralysis of one side only; (4) after unilateral convulsions there may be a paralysis of one limb only (especially the arm), while both have been convulsed; (5) the writer has seen a case in which a patient alternately had attacks of only paralysis or convulsions, or of convulsion followed by paralysis, always in the same limb—the left arm; (6) the writer has seen three cases of hemiplegia from brain-disease, in which the paralysis slightly but evidently *diminished* after each attack of convulsions. Several similar facts are on record; (7) Féré has found a loss of power after convulsions in 21 per cent. of his cases in the right arm, and in 23 per cent. in the left arm, while in cases in which, without convulsions, there was vertigo with or without loss of consciousness, the loss of power was 30 per cent. in the right arm and 27 per cent. in the left; (8) Dr. Hughlings Jackson has seen in those cases in which an abortion of the attack can be produced, that paralysis not only may appear, but can be greater than if convulsions had occurred. All these facts are in harmony with the idea that paralysis occurring in seizures either after or without convulsions is due to inhibition and not to exhaustion.

There are many reasons also to consider inhibition and not exhaustion as the cause of all the other losses of power which are sometimes observed after an attack of epilepsy, such as aphasia, amnesia, anæsthesia, loss of the muscular sense, amaurosis, deafness, anosmia, loss of taste, loss of knee-jerk. This is so true, that certain of these kinds of loss of function are sometimes, or even very frequently, as is the case for knee-jerk (Beevor), replaced by an increase of power.

Petit Mal.—The symptoms of a seizure of *epilepsia mitior* are very different from those of a violently convulsive attack of epilepsy (*haut mal*). The loss of consciousness occurs only for one or a few seconds, and the spasmodic contractions take place in a few muscles only—in the face, tongue, throat, eyes, and neck. If seized while standing up the patient rarely falls, and, on the contrary, if walking he may continue his movement as regularly as before the fit. If attacked while speaking, he generally stops while the consciousness is lost, and on recovering it he may complete the unfinished sentence, so that the bystanders may know nothing of what has occurred. Sometimes, however, the patient's mind is deeply altered, even when the attack of *petit mal* has been as short and slight as possible.

Nocturnal attacks of epilepsy may occur without any knowledge of their having taken place. Indeed, the writer has sometimes been consulted by persons who only asked for advice on account of headaches, and who had no pain in the head except after nocturnal attacks of epilepsy occurring without their knowledge. In such cases, the patient, after a seizure during sleep, wakes up tired, as if he had walked considerably; he has pains in the limbs, the back, and the head. He finds his mind confused, and his memory affected; he feels disinclined to get out of bed or to exert himself in any way; and often he is excitable or depressed. Sometimes his tongue or his lips are sore, and if the pillow is examined it shows bloody spots. More rarely it is found that an involuntary evacuation of urine has soiled the bed. Anyone sleeping within hearing distance of the patient may be wakened by the piercing epileptic cry, and then hear the noise of the shaking of the bed, caused by the convulsive movements. Such attacks, although very frequent and also very violent, may remain altogether unknown and unsuspected by the patient and his friends.

3. **Inter-paroxysmal.** — The general health of epileptics is usually very poor. Besides the alterations of their mental powers, and especially of their memory, they show a great deal of excitability and often depression of spirits. Their circulation and their digestion are often affected. There is nothing special, however, either in the morbid state of their mind and of their feelings, or in the disturbances of their physical health. Certainly the mental aberrations observed in the inter-paroxysmal state are not essential elements in the symptomatology of epilepsy. These aberrations can exist without epilepsy, and in a great many cases they are missing.

The *frequency of attacks* varies immensely in epilepsy. In one case the writer learned that for more than seventeen years the patient had passed no night without a fit, and for more than ten years the average nightly number of fits had been about twelve, which gives a total of more than forty thousand attacks in ten years. On the other hand, he was once consulted by a patient, sixty-two years old, who had had but seven attacks, the first of which occurred when he was nineteen years old, the interval between that and the second fit having been thirteen years, and the interval between the two last seizures having been seven years. Between extremely different cases like the two just mentioned we find the greatest variety as regards the frequency of attacks. Usually, however, there are a number of fits every month. If there are attacks with extremely violent convulsions, the frequency is generally much less than when the convulsions are slight. Seizures of *petit mal* are usually very frequent. A perfect periodicity is extremely rare, but an approximation to periodicity is not rare, especially in women. There may be singular and inexplicable periods; the writer knows of a number of cases with a weekly periodicity, and of a case in which for years attacks recurred every forty-nine days.

Status Epilepticus.—Bourneville, Féré, and Dr. Gowers have studied carefully this dangerous condition, which is often fatal to epileptics. As the writer will show about the treatment of *morbus comitialis*, it is important to know that this recurrence of a large number of fits, within a short period of time, with no return of consciousness between the attacks, may be the only kind of epileptic manifestations in some patients, in whom, after variable but sometimes almost perfectly periodical intervals, this so-called status epilepticus reappears. Usually, however, this frightful and very rapid succession of violent fits occurs in the worst cases of organic epilepsy due to disease of the brain, kidneys, or liver, and frequently then destroys the life of the patient.

Complications and Sequelæ.—Epilepsy has no necessary or usual complication. The diseases which often accompany it are frequently its causes and not complications. Bright's disease and other organic affections of the kidneys, diseases of the liver, the womb, and other viscera, when allied with epilepsy, if they have not been the first and only cause of it, are powerful additional causes. As regards sequelæ, the important researches of Dr. Hughlings Jackson, Dr. Hughes Bennett, and Dr. Féré have established that difficult speech, aphasia, amnesia, trembling, general physical and mental weakening, as well as any mental disorder, paresis or paralysis, anæsthesia, or great disturbances in the various organic functions, may not only appear temporarily as post-paroxysmal phenomena in epilepsy, but may persist and increase after each fit. The most common of those effects of seizures of this neurosis, and especially of *petit mal*, is amnesia, which may last, even if the epileptiform affection is cured.

Pathology.—The writer does not pretend to know what is the nature of epilepsy, so that when he tries to explain how that affection is produced and how its manifestations are generated, he will only state facts, and the conclusions they forcibly lead to.

I. As early as 1857 he endeavoured to show that one of the most essential features of epilepsy is an increased excitability of the reflecto-motor parts of the nervous system, which may exist not only in many parts of the centres, but also in some peripheric parts of the nervous system. The analysis of the phenomena which appear, after certain injuries, in guinea-pigs or cats in which epilepsy can be gradually produced, leads forcibly to this view. In these animals, a few days after a lesion which causes epilepsy (especially a section either of the sciatic nerve or of a lateral half of the spinal cord, in the dorsal region) the first morbid change to be detected consists in an increase of the reflex power of certain parts of the skin of the face and neck, while a greater excitability supervenes in the medulla oblongata, in the upper part of the cervical region of the spinal cord, and in some parts of the trigeminal and of the two or three first cervical nerves. Gradually the reflex excitability of the nerve-cells in direct communication with the fibres of the nerves we have named increases, so that irritation of the skin of the face and neck, instead of producing only, as at first, a reflex contraction of the neighbouring muscles, causes tonic or clonic spasms of all the muscles of the trunk, neck, and head, on the side of both the lesion and the irritation of the skin. Later on, the reflex spasmodic action extends to the other side, and at last (a month or later after the traumatic injury from which proceeds this series of effects) a complete attack of epilepsy takes place, characterised, as in man, by loss of consciousness, with tonic and clonic convulsions.

In cases of injury to certain parts of the base of the brain in some animals, the same changes may occur, but with two differences: 1st, the rapidity of increase in the reflex excitability of the parts above-named is very much greater than after an injury to the spinal cord or to the sciatic nerve; 2nd, the zone of skin that acquires the power, when irritated, to give rise to an attack is on the side opposite to that of the brain-injury, while it is on the side of the lesion of a nerve or of the spinal cord.

The writer cannot give here the many reasons showing that what takes place in animals rendered epileptic by the lesions mentioned, may be applied in a great measure to the production of epilepsy in man. He will only say that cases identical with those of his guinea-pigs have been published by several clinical writers.

After the important discovery of Fritsch and Hitzig, concerning the galvanic excitability of a certain zone of the cortex cerebri, it has been found that epileptiform convulsions can easily be produced by an irritation of that zone in monkeys, dogs, and cats. It is clear, therefore, that perfectly healthy animals can be rapidly rendered epileptic. Man also can be seized almost at once after a hæmorrhage in the brain or a fracture of the cranium.

II. In cases in which for the first time these spasmodic phenomena take place, the irritation which brings them on does this *only after having given rise to a morbid change constituting epilepsy* or an epileptiform affection. A longer time is necessary for the appearance of these convulsive movements than for any kind of natural reflex contractions.

The facts relating to the production of an attack of epilepsy by the galvanisation of certain parts of the cortex cerebri in monkeys, dogs, and cats, also show that a certain time is necessary for the production of the morbid state in which epilepsy consists. In that case also, as hereafter shown, the spinal cord is partly the seat of the genuine epilepsy generated. In other words, two distinct effects result from the irritative lesion —the one the genesis of the disease, *i.e.* of the morbid condition allied with which is the power of giving rise to epileptic or epileptiform attacks; the other, the production of a seizure.

III. Experiments in sudden crushing of the head in animals show that epilepsy can appear, although nothing remains of any part of the brain, *not even a portion of the medulla oblongata*, the connexion between the encephalon and the spinal cord having been altogether severed. Epilepsy, in the case of the crushing of the head, has its seat in the spinal cord, whatever be the share of the brain in giving origin to it. The writer, although recognising that fact about the location of this affection in such special circumstances, is not, and has never been, ready to admit that the spinal cord in all cases is the seat of this neurosis.

IV. The writer believes that the supposed absolute distinctions between the various kinds of convulsions (eclampsia and other forms of epilepsy due either to peripheric causes or to the state of the blood, &c.) are purely artificial and based only on the knowledge of the cause. All kinds of epilepsy may cause attacks, exhibiting the same essential features. In idiopathic, as well as in any other kind of epilepsy, an irritation which may come from any of the reflecto-motor parts of the nervous system, goes to a great many other parts of the nervous system, producing in some an inhibition of action or of power of action, and in others a simple expenditure of the normal or morbidly accumulated nerve-force, or, together with an expenditure, an increased generation of force (dynamogeny [1]).

Two facts forcibly show how these various effects of an irritation are produced.

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[1] The writer designates by that name just the contrary to inhibition. That action is the effect of a transformation of force due to an irritation, and in virtue of which there is a sudden or rapid production of force. A great many facts establish the dynamogenetic power of certain parts of the nervous system over other parts of that system and over contractile tissues. *See* his article 'Dynamogénie,' in the *Diction. Encyclop. des Sciences Médicales.*

(1) Under the influence of a very slight irritation—that of a superficial prick of the medulla oblongata, close by the *nib of the calamus*—the brain may be suddenly and (so far as the writer knows) irrevocably inhibited, so that all the powers and functions of that organ disappear, while, on the contrary, the spinal cord, the nerves, and the muscles gain immensely in power: they are *dynamogenised.* The loss of cerebral activity is not due to a diminution or a cessation of circulation in the brain, as, on the one hand, the heart, for a time, shows no great weakness, although breathing is stopped; and, on the other hand, the experiment succeeds although the cerebral blood-vessels are dilated owing to the previous extirpation of the two superior cervical ganglia.

(2) The other fact shows the simultaneous production of convulsions with inhibition and dynamogeny. Instead of pricking the medulla oblongata, that organ is suddenly crushed, and then it is found, first, that the powers of the cervical and of a part of the dorsal spinal cord are inhibited, sometimes so completely that they can be galvanised without producing any muscular action; secondly, that, for a longer time than in death by asphyxia, either tonic or clonic convulsions alone, or tonic followed by clonic muscular contractions, take place in the hind limbs; and, thirdly, that the power of that part of the spinal cord giving rise to convulsions is considerably increased, as shown not only by their violence and duration, notwithstanding the cessation of circulation, but also by the fact that reflex actions can continue to exist after convulsions have ceased.

The first of these facts clearly proves that one and the same cause—a very slight irritation in a certain part of the nervous centres—can change at once and everywhere the dynamical condition of the nervous and muscular tissues, inhibiting all the powers of the brain and increasing considerably the powers of the spinal cord, of its nerves, and of all muscles.

The second fact positively shows that an irritation of a certain part of the nervous centres can give rise simultaneously to three radically different effects—an inhibition; a production of nerve-force; convulsions due to an expenditure of nerve-force.

V. These facts throw a flood of light on the phenomena of epilepsy. First, they clearly show that it is by an act of inhibition that the loss of consciousness takes place. Secondly, they lead to the conclusion that convulsions do not require the pre-existence of a great quantity of nerve-force in any part of the nervous centres, and that they can take place, with great violence and last a long time, from irritations which need not be very great. The supposition that epileptiform fits depend on a sudden discharge of previously accumulated nerve-force is no longer necessary.

VI. The lesions found in many parts of the brain in epileptic patients do not show the *seat* of epilepsy—they only have one or the other of the three following significations: First, they are places of irritation generating that neurosis in the same way as peripheric lesions in the skin, in mucous membranes, in nerves, &c., produce it. Second, they may be mere co-existing alterations, having no influence over the epileptic affection. Third, they may be, and very often are, effects of the changes in circulation, in the state of the blood, and in cerebral nutrition, during fits. The alterations of the medulla oblongata, described by Schrœder van der Kolk, and more completely by Ch. Bouchard, are certainly, as pointed out by this last observer, effects of fits, but able, however, at certain stages of their development to have a share in some of the convulsive phenomena. The last effort recently made by Dr. Chaslin to establish that in idiopathic epilepsy there is a constant lesion, has failed like all others. That lesion, consisting in the existence of a diffuse sclerosis located chiefly in the grey matter, is so little the essential organic cerebral cause of that form of *morbus comitialis*, that Féré, in a case of cure of that affection, found that the brain was the seat of the cortical sclerosis, besides having an induration of the two cornua Ammonis.

VII. One only of the supposed seats of epilepsy in the brain deserves some attention. It is that part which is the most frequently found diseased in cases of unilateral epileptiform convulsions, whether Jacksonian in character or not—the so-called motor zone. That part is also very often diseased in cases of general epileptiform convulsions, and, not rarely, besides, in cases of apparently pure idiopathic epilepsy. This frequency of lesion of the so-called motor centres, in epileptic cases, may as well be due to the fact that an irritation starting from that place has given rise in other parts of the nervous centres to the morbid state in which epilepsy consists, as due to the fact that this peculiar morbid condition is really located there. In other words, a lesion of the cortex cerebri along the Rolandic fissure, like that of a nerve anywhere, may be only the location of an irritative cause and not the seat of this neurosis.

Many facts observed in animals and in man show that this supposition is the correct one. Experiments on dogs have shown to the writer that every part of the motor tract in the encephalon, after the production of an epileptic attack by the galvanisation of the so-called motor centres, can, on galvanic irritation, give rise to an identical convulsive seizure. They have also established the fact that it is on the motor cells of the base of the brain and of the spinal cord that the irritation of the cortex cerebri acts, in producing, first, the morbid state constituting epilepsy, and afterwards genuine epileptic attacks.

VIII. What is proved for dogs is, at least, extremely probable for man. Clinical facts show that most frequently any kind of lesion of the so-called motor centres or of the neighbouring frontal convolutions[1] has given origin either to genuine and complete epileptic fits, or to the greatest variety of epileptiform manifestations. This has led to the erroneous conclusion that epilepsy has its seat in certain cortical parts of the brain. It can be shown that all parts of the cerebrum, of the cerebellum, of the base of the brain, and also the cerebral meninges, the spinal cord, and the centripetal nerves, can produce epilepsy. On the other hand, irritative lesions are known to have existed, in many cases, in one or another part of the frontal or parietal lobes without the appearance of epilepsy.

When any kind or form of that affection appears under the influence of a disease or of an injury to the cortex cerebri in the parts looked upon as its real location, the altered tissue, as the following facts well show, may be only the seat of an irritation acting on other parts of the nervous centres, so as to give rise to epilepsy and to its manifestations. This view is proved by the facts—1st, that when this neurosis is due to a worm in the bowels, it can be cured by the expulsion of the irritating cause; 2nd, that when it depends on a neuroma, or neuritis, it can be cured by the section of a nerve between the diseased peripheric part and the nervous centres; 3rd, that when caused by some pathological alteration of a cerebral convolution, it can be cured by the excision of the diseased part. In all those cases there is a cure, not because the seat of this convulsive affection is separated from the nervous centres, but because the irritating cause is suppressed.

Sometimes, as is well known, epilepsy will continue after the expulsion of a worm, the section of a nerve, and the excision of a diseased convolution, or the opening of a cerebral abscess. In the first place, the irritative cause may be only partly suppressed by those means; in the second place, as said already, the morbid state in which epilepsy consists may exist in other parts of the nervous system than those where the irritative causes are located. That morbid condition may persist, remaining able, under the influence of other irritations than those which acted previously, to give rise to seizures.

IX. Together with the conclusions flowing from the facts and arguments above discussed, the writer will give some others, the grounds for which lack of space does not permit him to mention:—

1. Epilepsy is a reflex neurosis even when positively allied with an organic lesion of the brain. Its only constant feature is an increase of the reflex excitability of a number of nerve-cells located in various parts of the cerebro-spinal centres. That hyper-excitability is generally, but not necessarily, greater at the time of an impending fit.

2. No distinction can be made between the kinds of epilepsy, with predominances either of considerable disturbance of the mental functions or of the higher senses, or of convulsive movements, or of any symptom. The greatest variety of epileptiform manifestations can arise from a similar lesion in any part of the brain or elsewhere.

3. Some parts of the nervous centres are always ready to cause, rapidly but not immediately, all or some of the phenomena of epilepsy, under the influence of an irritation, and especially a sudden one, proceeding from any central or peripheric part of the incito-motor nervous system. Two successive and absolutely distinct actions take place then: the first is a morbid change in the properties of a number of cells of the nervous centres—change according to which epilepsy or an epileptiform affection is generated; the second is a reaction from those cells bringing outwardly the manifestations of the special kind of the neurosis produced.

4. All the manifestations of genuine epilepsy, even in its worst and inherited form, in certain animals, can take place after the destruction of the whole brain, including every part of the medulla oblongata.

5. The seat of epilepsy is not where an organic lesion or a traumatic injury is found, either in the brain proper, the cerebellum, or any other part of the nervous centres, nor in any nerve or viscus. All organic lesions are only foci of irritation, seats of causes. The true location of the morbid state constituting epilepsy or an epileptiform affection is in reflecto-motor nerve-cells in parts of the central nervous system varying extremely.

6. Attacks of epilepsy are not essentially due to an overflow of nerve-force accumulated anywhere. The same irritating cause which brings on an attack can produce nerve-force at the same time that it determines convulsions by discharges of that force.

Diagnosis.—In most cases it is easy to distinguish epilepsy from the few affections which resemble it. Sometimes, however, difficulties exist. There is no essential difference between the attacks of eclampsia in women and children and attacks of epilepsy, except the existence in eclampsia of a peripheric cause of irritation, which is likely to disappear. But those purely reflex epileptiform attacks in women and children are sometimes succeeded by genuine attacks of epilepsy. Changes in the nervous centres occur during the eclamptic attacks, and lay the foundation of persistent epilepsy, although the peripheric irritation, which was the first cause, has ceased to exist. It is sometimes, therefore, almost impossible, as regards children especially, to say if we have to deal with eclampsia or epilepsy. The same may be said of all kinds of attacks of loss of consciousness and convulsions due to a peripheric cause, whether we call the affection eclampsia or reflex epilepsy (*see* CONVULSIONS). The first cause in these cases may cease to exist without our discovering positively that it has disappeared, and still attacks may continue. A mistake is not dangerous, as the treatment will be very much the same, except that in purely reflex epilepsy we have to fight against the peripheric cause, besides making use of means against epilepsy itself.

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[1] Dr. J. Hughlings Jackson, in his late remarkable 'Lumleian Lectures,' has put forward the supposition that the seat of 'complete or genuine' epilepsy is in the prefrontal lobes. Against this supposition the writer will only say that all the characteristics of this affection have existed when these lobes were either absolutely normal or completely destroyed.

As regards the known facts concerning the ætiology of epilepsy and hysteroid affections, it must be remembered: (1) That, instead of epilepsy, hysteria may appear in the descendants of epileptics; (2) that an organic disease of the brain can give rise to genuine hysteria or to mixed forms of hysteria and epilepsy; (3) that diseases of the womb or even of the ovaries can give origin to epilepsy, and diseases of the testicles to hysteria; (4) that traumatic causes, and especially injuries to nerves, can sometimes produce hysteria; (5) that syphilis, uræmia, worms in the bowels, lead poisoning, can give rise to hysteroid affections. Ætiology alone cannot, therefore, be decisive for the diagnosis between epilepsy and hysteria.

The aura hysterica and the epileptic aura are generally very different one from the other, but they may be quite similar. The writer has seen a case of idiopathic epilepsy in an adult male, in whom the *globus hystericus* was the warning of almost every attack. As regards other means of diagnosis, we will refer to the articles HYSTERIA and HYSTERO-EPILEPSY.

Epilepsia mitior (*petit mal*) sometimes cannot be recognised easily from syncope. In *petit mal*, however, the loss of consciousness is absolutely sudden; the eyes are fixed; almost always some muscles of the face are contracted; sometimes other muscles, in the neck and elsewhere, are also contracted; if the patient is standing he rarely falls, and if he is walking he may continue to do it. The attack is very short, and there may be no appearance of its having occurred, except that some mental disorder may follow it; the pulse may be diminished, but it never disappears altogether. Syncope differs from *petit mal* in all those characteristics.

It is not necessary to draw here the lines of diagnosis between idiopathic epilepsy and cerebral epilepsy. The characteristic features of this last affection have been described at length in several parts of this article.

PROGNOSIS.—Inherited epilepsy is very rarely cured. The writer can positively state, however, that it may be cured. Among other good cases of persistent cure, he has seen two extremely remarkable. The patients were first cousins, and had inherited the disease from a grandmother: one of them died from a fall while intoxicated, five years after his last attack of epilepsy; the other died from typhoid fever, seven years after his last attack. They had both been treated for about two years, in 1852 and 1853.

There is a very great difference as regards prognosis between pure idiopathic epilepsy and other forms of that neurosis. The possibility of cure is greater when some curable or amendable organic alteration exists as a cause of epilepsy. One form of this nervous affection—that which is due to some congestion or even a more serious alteration of the brain, consecutive to typhoid fever, scarlatina, or measles—is often much benefited by treatment, if not cured. Already, before the great progress in the treatment of epilepsy through surgical means, the writer looked upon epilepsy caused by disease of the brain—syphilitic or not—as much more curable than any of the forms of this neurosis, excepting, perhaps, that which is due to an easily removable peripheric irritation. Epilepsy beginning in childhood, from teething or a bowel complaint, and having lasted many years, is almost incurable.

TREATMENT.—*Abortion of the attack.*—A most important fact ought at first to be pointed out under this head: it is that, as every attack causes in the nervous centres changes which prepare other attacks, it is essential to produce, if possible, the abortion of attacks whenever warnings occur. The treatment to obtain such an abortion varies with the kind of warning. In cases in which a real aura exists many means can be employed with the greatest benefit. The writer long since showed that the old-fashioned mode of prevention of attacks, consisting in the application of a ligature round a limb, acts not as the Galenic doctrine supposed that it did—that is, by barring the way to something going up to the brain; but, on the contrary, in doing just the reverse—that is, by sending an irritation towards or rather to the nervous centres. The writer has also shown that the ligature need not be left applied, and that a greater success is obtained by tying suddenly a handkerchief or a band, and repeating this tying several times in succession, than by applying the ligature even very tightly and leaving it so. Besides, he has found: (1) that the ligature can do good even when applied on another limb than that where the aura is felt, although it is more efficacious on the latter; and (2) that pinching or striking the skin, or irritating its nerves by heat, by cold, by galvanism, or by repeated pricks with a needle, will generally do as much good as the ligature.

In those cases in which an involuntary muscular contraction takes place before an attack—that is, before the loss of consciousness—one of the most efficient means to produce an abortion of the fit is to draw forcibly on the contracted muscles, so as to elongate them. For instance, in those cases in which the unconsciousness is preceded by a contraction of the muscles of the neck, which draws the chin towards one shoulder, turning forcibly and rapidly the head towards the opposite shoulder gives in most cases a very good chance of checking completely the tendency to the fit. In case of contraction of the flexor muscles of the forearm, forcible extension of the hand over the forearm may succeed in preventing the attack. A blow, pressure, or friction on parts where some muscles become rigid, may have the same favourable effect.

If there are disturbances of breathing among the premonitory symptoms, the inhalation of ether or chloroform may prove successful. In cases of laryngismus similar means, or the cauterisation of the fauces by a strong solution of nitrate of silver, has been found most useful by the writer. The use of anæsthetics as a means of warding off an attack is too much neglected. By the help of ether in inhalations the writer succeeded, with Mr. R. Dunn, in preventing an attack in a patient who had had a fracture of the arm in a previous seizure, and who used to have a fit regularly every week. A whole week was gained in that way. In some cases the recurrence of attacks has been warded off by giving chloroform or ether (by inhalation) to patients who had had the first of what would have been otherwise a series of many fits. There is, in cases in which a fit is expected, a considerable chance of preventing it by anæsthetics.

According to the kind of warning and to its seat, one means or another out of a very large number (some of which only shall be mentioned here) ought to be used. An emetic, a purgative, a stimulant, the immersion of the two hands in hot water, the application of a lump of ice to the back of the neck or between the shoulder-blades, the subcutaneous injection of a solution of $\frac{1}{50}$ of a grain of sulphate of atropine with $\frac{1}{3}$ of a grain of acetate of morphine, powdered *asarum* taken as snuff, a dose of 25 grains of hydrate of chloral, the inhalation of a small dose of nitrite of amyl, extremely rapid and ample voluntary respiratory movements for five or six minutes, jumping, running for at least ten minutes, reading very loud and fast—such are some of the means which the writer has found to be the most successful.

In a number of cases, patients under the writer's care obtained abortion of an impending fit by making energetic movements Sometimes, however, even when the warning allowed the performance of very powerful general movements for a long time, the fit came with its usual violence. These facts are in decided opposition to the view that attacks of epilepsy are the effects of discharges of accumulated nerve-force by the so-called motor centres, or by other parts of the brain. Just as the tension of vapour diminishes in a boiler when steam is let off, the amount of nerve-force should diminish as a necessary consequence of the expenditure taking place in voluntary movement.

The second point of importance about treatment is to try to discover a part of the body which can by irritation give rise to a premonitory symptom of an attack, or even to an attack itself. If such a part is discovered, counter-irritation of some kind is to be applied there. Our remarks must be confined to saying that hard pressure on certain parts of the head, the spine, the breast, the abdomen, or the limbs, has in a number of cases produced an attack or some symptoms of it. We have seen the passage of a galvanic current produce the same effect. In such cases a blister or other local application has done good in diminishing the violence or frequency of attacks, and even, in a few instances, helped notably to a cure.

It is a remarkable fact that, whether a sensory or muscular aura exists from some affection or injury in the neighbourhood of its seat in the periphery, or from an organic affection or a traumatic injury of the nervous centres, the best place of application of any means of abortion of an attack, or of cure of epilepsy, is the same—*i.e.* the skin near the seat of the aura, or along the passage of nerves going to that seat. If a place, which is not connected with an aura, is found to be capable under an irritation of giving rise to a fit, there also is the best situation for the application of counter-irritants and other means of treatment against the epileptic affection. One of the most powerful means of counter-irritation, in all cases like the above, is a circular blister to be applied all round a finger, a toe, or an arm or leg. This means, used also with benefit by Dr. Buzzard, has led him to find that sometimes the aura, under the influence of a circular blister, disappears from the limb so treated, and is transferred to homologous places of the other side. In a case of epilepsy of Récamier's, a sensory aura changed place a great many times, and each time after an application of a small blister. The aura so pursued disappeared, and the patient was cured.

Treatment during the attack.—The best plan in most cases of epilepsy is simply to save the patient from the danger of striking anything which might cause a bruise; to loosen his clothing, cravat, &c., so as to give freedom to respiratory movements; to wash the face with cold water if it become covered with perspiration; and at last to turn the head and face at the end of the fit, so as to prevent the falling back of the tongue on the glottis, and even to draw forward the tongue if there is deep stertorous or comatose breathing. There is, however, one means of treatment which has certainly proved sometimes successful in curtailing an attack even in so-called idiopathic epilepsy, although it is more powerful in partial epilepsy due to brain disease or to some peripheric irritation: this is pressure on the part of the neck where lie the carotid arteries. The idea was to lessen the amount of blood going to the brain. Whether obtaining that effect is really of service or not the writer cannot say, but, as often stated by him, it is not possible to press strongly over the carotid arteries without pressing also on the cervical sympathetic and on the nervi vagi. It is known that Augustus Waller and Czermak have ascertained that in man, as in the mammalians, pressure on the carotid artery acts sufficiently on that nerve to inhibit the heart more or less completely. This effect is certainly quite capable of curtailing a fit. The writer has shown also that such pressure can act on the nerve so as to modify favourably the condition of the respiratory centres, and he has proposed to employ pressure on both carotids and neighbouring nerves in those cases of epilepsy (and also of apoplexy) in which the heart beats very violently, while the respiratory muscles partake of the general convulsions.

Treatment of epilepsy itself.—The modes of treatment of the various forms of epilepsy which chiefly deserve to be noticed, must be divided into two classes, the internal and the external and surgical. We will first speak of internal means.

Against idiopathic epilepsy the most powerful means consists in the simultaneous use of some tonic remedy (such as strychnine or arsenic) to be taken after meals; and of a mixture composed more or less like the following:—

℞ Potassii iodidi ʒij.
Potassii bromidi ℥j.
Ammonii bromidi ʒiij.
Potassii bicarbonatis ʒj.
Tinct. calumbæ ℥j.
Aquæ destillatæ ℥vj.

Of this solution four doses a day may be given to adults, three of one teaspoonful each before meals, and the fourth of three teaspoonfuls at bedtime, with as much water as desired. According to many circumstances the dose of one or another of the ingredients is to be changed. For example, if the *petit mal* exists alone, or co-exists with the complete epilepsy, the dose of the bromide of ammonium must be larger, and that of the other bromide diminished. If there is a weak pulse, carbonate of ammonium is to be substituted for the bicarbonate of potassium. In the writer's work on functional nervous affections all the rules relating to this mixture are given, and he will only say now that its use is considerably more beneficial than that of any of its ingredients alone, or any two of them. Two essential rules are to be followed when bromides are employed against epilepsy. The first is, that there ought to be no cessation whatever in the use of such remedies, as the whole benefit that may have been obtained may be lost at once after an interruption of even only a few days; the second is, that the treatment must be persevered with for at least two years after the date of the last attack. There is no evident harm in the great majority of cases from a prolonged use of a mixture like the above; a large number of patients have taken it for many years without any marked bad effect.

The writer has tried many other bromides than the two of this mixture. None has answered so well as these two. In a great many cases he has made use simultaneously of this mixture and of one or another of the many remedies which have been proposed for epilepsy. None of them has proved very useful except when there was some local affection which could be benefited by the added remedy. Such has been the case with atropine, ergotin, cannabis indica, digitalis, aconitine, cod-liver oil, &c.

In those cases in which the above mixture either did not produce a sufficiently good effect, or, still more, allowed of an increase of the convulsive neurosis or of *petit mal*, the use of atropine, of the ammoniated sulphate of copper, of borax, of the oxide or other salt of zinc, has frequently proved useful. It is not possible to say in what kind of cases one of these remedies is to be used rather than the others, except that zinc seems to be of better use when hysteria is more or less mixed up with epilepsy.

The writer has obtained a permanent cure of two cases of idiopathic epilepsy through the agency of nitrate of silver, without any discoloration of the skin. He employed a small dose ($\frac{1}{8}$ of a grain three times a day), and stopped giving the medicine for eight or ten days after having had it used for three weeks. It required nearly a year for the complete cessation of the fits, and the use of the remedy was continued a few months after the last attack.

Petit mal, as well as complete epilepsy, can be treated advantageously with the above-mentioned mixture. Much benefit will sometimes be obtained in the treatment of this special neurosis by the addition of arsenic or of atropine.

It is hardly necessary to say that, when syphilis is the cause of epilepsy, the dose of the iodide of potassium in the prescription is to be notably increased (it must be at least a drachm a day), and also that frictions with the mercurial ointment are often to be resorted to. If epilepsy depend on some visceral affection, it is clear that the treatment should be directed against that affection. But if the liver is diseased from some influence of malaria, the sulphate of quinine should not be given, as it is almost always a bad remedy to employ in epilepsy, often more hurtful than useful. Arsenic should then be the remedy used for the sequelæ of fever and ague. If quinine must be employed in cases of clearly periodical epilepsy, the valerianate should be given.

The writer's experience shows that in most cases of epilepsy iron is harmful rather than useful. It is only in cases allied with or caused by chlorosis or considerable anæmia that the good effects of iron or manganese are often very marked. Still, the citrate of iron, although less powerful against a deficiency of blood-globules, may be used, because it is less apt to give rise to attacks than are most ferruginous preparations. Writers who disagree with these views (which are accepted by Dr. Hughlings Jackson) have lately tried to show that iron can always do some, if not much, good, and can do no harm; but they have, in support of their statements, given cases belonging rather to hysteroid affections than to epilepsy.

The writer has obtained no decided good effects from nitrite of amyl, antipyrin, picrotoxine, curara, or simulo.

It is important to state that, in cases of status epilepticus, the prompt and continued use of anæsthetics (ether, chloroform) may stop the tendency to the recurrence of fits. The condition of the tongue must then be watched carefully. If, as is usual, the fits are very violent, this organ falls over the larynx and increases the state of asphyxia, which contributes to the return of convulsions. The tongue is to be drawn forward, and any accumulation of frothy or bloody mucus in the throat must be wiped out. Anæsthetics have some power of curtailing, if not stopping at once, the tendency to a return of fits.

External and surgical means.—The notion that, if epilepsy depends on a peripheric cause which can be removed, it is right to employ surgical means, has often been acted upon, and with decided benefit. The number of cases is large in which a cause has been profitably suppressed by an operation or some other means. In a good many such cases, the section of a nerve or the extirpation of a foreign body or a tumour has proved successful. Lately some cases of stretching of nerves, followed by cure or amelioration, have been published. A great deal is to be expected from counter-irritation. Ice applied on the bare skin, the actual cautery, or sedative applications on sores, may do much good.

As regards cases of idiopathic or cerebral epilepsy, all kinds of counter-irritation on the nape of the neck or at the level of the first and second dorsal vertebræ may prove useful, especially if there is considerable pain or heat in the head. When attacks are very violent and frequent, a decided amelioration may be obtained from croton-oil applications on a great part of the shaved scalp. Setons and issues very rarely do any good, and often weaken and irritate.

Among surgical means against epilepsy, two bold and somewhat strange operations have successively been proposed by an able surgeon, Dr. W. Alexander, of Liverpool: the one was supposed to act in producing anæmia in the base of the brain; the other, on the contrary, was to cause a vascular fulness. The first of these means consisted in the ligature of both vertebral arteries. Out of 36 cases there was a temporary cure or a persistent amelioration in 19 cases—certainly a very large proportion. Having given up this therapeutical means, Dr. Alexander formed the idea of taking away on the two sides the superior cervical ganglion of the sympathetic nerve, and obtained this remarkable result—that there was a cure or an improvement in 25 per cent. of the cases, while it is generally admitted that medical treatment gives about 7 per cent. of cure or improvement. The writer, notwithstanding the apparent superiority of this kind of treatment, would be quite indisposed to recommend it except after complete failure of all the best internal remedies.

Operations on the genital organs of epileptics of the two sexes are only to be resorted to in desperate cases.

Trephining against epilepsy, during a great part of this century, although employed indiscriminately, has nevertheless frequently proved useful. It is now, in appearance, used according to rational scientific principles—in reality sometimes quite faulty. Statistics show that, with the addition of very bold operations, it is not so frequently useful as it previously was. In other parts of this article (Ætiology; Symptoms) there are facts showing that recognition of the seat of a tumour or of some other organic disease of the brain is not always possible, and must in many cases be extremely difficult. Be that as it may, it is quite certain that not rarely after the laying bare of the dura mater or the cerebral convolutions, surgeons have been disappointed in not detecting an expected morbid state to which they attributed an existing epileptic affection. On the other hand, however, they were, sometimes, agreeably surprised in finding that in such circumstances the affection disappeared. In 1857, after having given all the details of a case of the kind, furnished to him by Dr. van Buren, the writer in his work on Epilepsy put forward a view, very tersely expressed a few years ago by Dr. Gowers in the following sentence: 'It is possible that the measure (trephining) is sometimes beneficial as an energetic form of counter-irritation, but it is doubtful whether for this object its performance is justifiable.'

Knowing how powerful counter-irritation may be against epilepsy caused by a blow on the head or allied with some tenderness of a point of tho scalp, the writer long ago proposed that, before resorting to trephining, the most energetic means of counter-irritation should be employed. Trials should be made of ice applied on the shaved and bare skin of the head twice a day for an hour each time, of the actual cautery, of blistering, of croton oil, and of a means which the writer (imitating Pouteau) used successfully in two cases, consisting in a deep crucial incision of the scalp and the pericranium (the cuts being of one inch and a quarter). It is possible that it was a more or less similar operation, and not the trephining, which was the means of success in the cases above mentioned.

When we read of cases of cure after the extirpation of bony spiculæ or of a mass of cicatricial tissue, of a tumour, or of a certain amount of the convolutions of the brain, it is impossible not to be struck with the resemblance of these facts to the cases of cure of epilepsy by the expulsion of worms from the bowels, or the removal of a neuroma or a foreign body pressing on a nerve, or of other causes of peripheric irritation. The analogy between the cerebral and the peripheric cases is very great: both are cases of reflex epilepsy. In both kinds of cases there may be a failure of the means used, owing, no doubt, to changes having occurred in the nervous centres which are able to give rise to attacks of epilepsy. In such cases the excision of the supposed centre of certain muscles may not be followed by a cessation of convulsions of those parts. So it was in the case of a boy spoken of by Dr. Ferrier, and who had been operated upon by Mr. V. Horsley.

Notwithstanding the diminution of risks due to antiseptics, great is still the proportion of deaths following, if not caused by, the operation of trephining, with the ablation of morbid parts of the brain, and sometimes, alas! of perfectly healthy-looking parts.

Thero is no doubt that surgeons are entitled, in certain cases, to employ trephining against epilepsy; but, for the reasons above briefly given, the writer thinks that, before resorting to this operation, when there is no clear evidence that some morbid parts are to be removed or an abscess to be opened, or some necessity arising from a fracture, it would be wise to first exhaust all means of counter-irritation.

C. E. Brown-Séquard.

EPILEPTIC INSANITY.—Synon.: Fr. *Folie épileptique*; Ger. *Epileptisches Irresein.*

Definition.—Mental disorder which is the outcome of the epileptic neurosis, and which is generally, though not invariably, accompanied by motor epilepsy.

Ætiology.—The statements in the article Epilepsy may be taken generally as applicable to epileptic insanity. But an exception must be made in regard to what is said concerning sympathetic epilepsy, the insanity described here being associated only with epilepsy of cerebral origin.

Pathology.—The structural changes associated with epileptic insanity have their seat in the cerebral cortex, and involve an altered nutrition of certain of the nerve-cells. This altered nutrition is usually due to idiopathic degeneration; but it may also be due to morbid growths or other irritative lesions in neighbouring parts of the brain. It seems probable that functional disturbance of the cells in the higher centres or psychic areæ may be excited by radiation from the motor area in which an epileptic discharge originates; but in most cases there can be little doubt that the cells in the psychic areæ are themselves the subject of structural change. In some cases, indeed, the psychic centres are the first affected, and the discharges may be at least for a time limited to these centres. In such cases the discharges are manifested by loss of consciousness, hallucinations, or outbursts of mania unaccompanied by convulsions. The structural change chiefly occurs in the small irregularly shaped nerve-cells which are found in the second cortical layer. Bevan Lewis regards as of a highly characteristic nature a fatty degeneration of the nuclei of these cells, which goes on to vacuolation, and ends in complete disintegration of the cells. He describes similar changes as usually affecting to some extent the other layers of the cortex. This form of degeneration is not, however, as Bevan Lewis himself shows, peculiar to epilepsy; and other observers, though using Bevan Lewis's own method of examination, have failed to find it in some cases of epilepsy. When a patient dies in a fit, there is usually found intense venous engorgement with sometimes punctiform hæmorrhages in all the viscera, including the brain. This condition has important pathological bearings; but it is post-epileptic in its nature, and is properly regarded, not as the cause, but as a result of the epileptic seizure.

Description.—It is necessary to consider separately three aspects of the unsoundness of mind which is associated with epilepsy, according as it appears (1) as arrested or impeded mental development—*epileptic idiocy* and *epileptic imbecility*; (2) as progressive mental degeneration—*chronic epileptic insanity*; and (3) as transient mental disorder —*acute epileptic insanity* or *epileptic mania.* These three conditions are to be regarded as different phases and not as different kinds of epileptic insanity. They are intimately connected with one another, and occasionally they may all be illustrated in the progress of a single case. Thus epilepsy supervening during infancy or youth may so retard mental development as to produce imbecility; the subsequent periodical recurrence of epileptic fits during adult life may gradually pervert and deprave the already imperfect intelligence, causing it to pass through a phase characterised by emotional disorder, hallucinations, and delusions, and ending in the hebetude of complete dementia; this progress may occupy many years, and it may be interrupted by intercurrent outbursts of acute maniacal excitement. Though it is necessary, therefore, for the purpose of description to deal with each of the phases separately, their interdependence must not be overlooked.

1. **Epileptic Idiocy and Epileptic Imbecility.**—These terms are used to indicate different degrees of the same affection—a more or less complete arrest of mental development due to epilepsy. Those individuals in whom epilepsy supervenes in infancy, where there is no development of mind, or very little, are called idiots. Those in whom epilepsy commences after substantial progress has been made in mental growth, or in whom the epileptic seizures, though appearing early, do not recur frequently, and where there is considerable though defective mental development, are called imbeciles. The effect of the fits upon the mental condition of children differs greatly in different cases. The fits are usually followed by more or less mental retrogression. In many cases after a fit, and especially after a series of fits, the patients fall into a state of prostration and stupor of some duration. The educational training of the epileptic imbecile is seriously embarrassed by the occurrence of such attacks. A great part of what has previously been learnt seems to be wiped out, and requires to be learnt over again. In cases where the fits cease the evolution of the intellect may resume its course, but the mental organisation always remains damaged. It is estimated that about one-third of the total number of cases of idiocy are due to epilepsy.

2. **Chronic Epileptic Insanity.**—In a large number of epileptics, estimated by Russell Reynolds at about one-third of the total number, the mental condition is not affected to such a degree as to be recognised as abnormal; and in a small number of cases the disorder is limited to a few brief attacks, sometimes to a single attack, of maniacal excitement. In about two-thirds of the cases there is an appreciable mental enfeeblement which gradually increases so long as the fits continue to recur, in some cases never going farther than a peculiar emotional mobility and weakness of memory, and in others passing on to profound dementia. This progressive mental degeneration, though varying greatly in degree, is very uniform in type, and it is important to be able to recognise it. In the mildest cases there are usually to be detected lapses of memory, fits of absent-mindedness, and transient confusions of thought; and there is always more or less instability of mood and morbid irritability. The instability is the most characteristic mental feature of the epileptic. At one time he will be gloomy, despairing, conscious of his mental enfeeblement, and lamenting its hopeless nature; at another time he will exhibit a surprising self-satisfaction, hopefulness, and confidence. Many epileptics are liable to fits of intensely passionate anger, occurring without apparent cause. The changes of mood often take place with a startling suddenness which is important as a diagnostic indication. In the fully developed chronic insanity of the epileptic the variableness of the mental condition may show itself in the intellectual as well as in the emotional state. A patient who usually exhibits confusion of thought, weak memory, and little power of attention may suddenly awake to a state of great mental activity, and show remarkable clearness and rapidity of thought, vivid memory, and great power of concentration. A common condition is to be habitually quarrelsome, argumentative, fond of teasing, insolent in demeanour, and given to capricious cruelty; yet such patients will sometimes be found marvellously sweet in disposition, benevolent, affectionate, and considerate. In the advanced stages of the disorder the moral nature is generally deeply degraded, as shown in repulsive obsequiousness of demeanour, low cunning, treachery, and cruelty. The intellectual condition also passes through stages of degradation. Delusions of being injured by other persons fill the mind, and visual and auditory hallucinations occur. When these are present the patient, with his tendency to impulsive passion, is dangerous to persons near him. The last stage is marked by complete loss of moral sense and mental capacity. Nothing remains but the lower instincts in their most degraded form; and this is accompanied by a physical debasement which accords only too well with the mental condition.

3. **Acute Epileptic Insanity—Epileptic Mania.**—The term 'epileptic mania' is used to denote a peculiar automatic form of acute mania which sometimes follows epileptic seizures, and more rarely occurs in

persons with the epileptic neurosis who have never had a convulsive attack—or at least who have not been known to have one. There is generally some transient mental perturbation preceding or following a convulsive seizure, which does not attain the intensity of mania, but which may be fitly alluded to here. The pre-paroxysmal phase of these perturbations may last for a few hours or a few days. They consist in a development of conditions which have been already described as characteristic of the early stage of chronic epileptic insanity. Sometimes there is morbid irritability, depression, or exaltation, sometimes confusion of thought or loss of memory. Immediately before the occurrence of a fit there is often some special idea which rivets the attention, the recollection of some particular scene, or a special hallucination such as a flame, a red colour, a spectre, or a peculiar odour. When there is a particular idea, or an hallucination, it is usually the same which recurs at each seizure, and it generally has some relation to the circumstances in which the first fit occurred. After the convulsive fit has passed off, there is frequently a short period of confusion of thought, and lethargy. The condition known as epileptic mania is an outburst of maniacal excitement lasting from a few hours to several days. The general features which are distinctive of these attacks are the suddenness of their onset, the violence and abrupt rapidity of the acts of the patients, the painful and appalling nature of the ideas and hallucinations from which they suffer, the suddenness as well as the completeness of the return to sanity, and the entire, or nearly entire, forgetfulness of what has happened during the course of the attacks. During an attack the impulsive acts are often of a homicidal or suicidal character, and this makes epileptic mania one of the most dangerous of all kinds of insanity. Sometimes the attack is characterised by furious maniacal excitement during its whole course, but there are also cases in which there is an apparent calmness of conduct. In a typical case of this kind the patient is irritable, suffers from a vague terror, seems impelled by a force, which he feels irresistible, to commit acts without conscious purpose. In this state the patients will walk long distances without object, steal or destroy articles in an unaccountable way, and will commit homicide or suicide with apparent deliberation. They seem insensible to everything which does not fall in with their dominant idea or impulse. This automatic action is a special characteristic of epileptic mania, both in the cases where there is violent excitement, and in those where there is an appearance of deliberate co-ordination of thought and act. The patients are as if in a waking dream; and when they awake suddenly to rational consciousness, they feel as if they had passed through a dream which they dimly conceive to have been of a distressing and frightful nature, but of whose details they have no recollection, or only a very vague one.

The relation of the mental disorder to the convulsive seizures is concisely given in the following sentences. When the fits are frequent, and continue through a course of years, they are generally associated with chronic epileptic insanity, though there are exceptional cases in which the mind is not seriously affected. Where the fits are frequent, and are of the character of *petit mal*, the mental degeneration is usually more rapid and complete than where the motor symptoms are more severe, as in the *grand mal*. The calmer type of epileptic mania, called by Falret *petit mal intellectuel*, is most frequently associated with fits of the character of *petit mal* and with nocturnal fits; while the violent excitement, called by Falret *grand mal intellectuel*, is most frequently associated with the severe motor fits. Epileptic mania is most frequent after a fit or a series of fits, is less frequent before a fit, and least frequent in the intervening periods; it is specially apt to occur after a recrudescence of fits following a long period of freedom from them. It is also apt to occur after a rapid succession of abortive fits. It is rare in the first stages of epilepsy, most frequent in the middle stage, and rare after dementia has begun.

Treatment.—In the treatment of epileptic insanity everything which is useful in the treatment of epilepsy is to be included (*see* Epilepsy). The bromides are the most important remedies, especially bromide of potassium. It should be given persistently in doses just short of producing bromism, combined with small doses of arsenic. It may be given for years if necessary. When syphilis is present, the bromide should be combined with the iodide. When pre-paroxysmal symptoms are observed, 20 grains of chloral hydrate should be given and the patient put to bed. The same treatment is useful after a fit; and it may also arrest a fit, or series of fits, or ward off an attack of epileptic mania. Constipation and overloading of the stomach with food should be carefully avoided. There should be complete abstinence from alcohol; it is apt to bring on fits and also mania.

Medico-legal Relations.—Where responsibility for acts committed in what seems to have been an attack of epileptic mania is in question, the whole character of the mental symptoms and the evidence of other epileptic conditions must be kept in view. The difficult cases are those in which there has been no violent excitement, and when the conduct has had the character of the calmer type of epileptic mania. Here it is important to bring clearly out the automatic character of the conduct. But the most important point is the existence of the fits. It may happen that the fits have not been recognised though they were really present. Nocturnal fits are the most likely to escape recognition. It must not be forgotten that they may have occurred without the knowledge of the patient himself. Careful inquiry should therefore be made for signs of their occurrence, such as biting of the tongue, of the lips, or of the cheek; spots of blood on the pillow; gathering of froth about the mouth on waking; unconscious emission of urine; peculiar fits of snoring; or the occurrence of numerous small ecchymoses under the skin of the neck or forehead, the last being a sign the importance of which is strongly insisted on by Trousseau. When no convulsive fits can be ascertained, evidence of vertigo, or of brief losses of consciousness occurring periodically or in series, should be looked for. If in the opinion of a medical witness an act of violence has been the result of epileptic insanity, it is his duty to show that not merely the act itself, but also the conduct and condition of the accused otherwise, are symptomatic of the epileptic condition. John Sibbald.

EPILEPTIFORM **EPILEPTOID**.—Partaking of the characters of epilepsy; terms generally applied to convulsions. *See* Convulsions.

EPIPHORA (ἐπί, upon; and φέρω, I carry).—A flow of tears so persistent that they run down the cheek, due either to obstruction of the lacrymal duct or to excessive secretion. *See* Lacrymal Apparatus, Diseases of.

EPIPHYTA (ἐπί, upon; and φυτόν, a plant).—These are the plant-like organisms found on the skin and its appendages, or on mucous surfaces, the so-called *vegetable-parasites*, originating certain diseases, such as the various forms of tinea and thrush. The more important of them are the achorion, trichophyton, and microsporon. The achorion Schönleinii is the vegetable fungus which constitutes the mass of the crusts of favus, and belongs to the group of oidia. The trichophyton is the dermatophyte of tinea and sycosis, and is found in the substance of the hair as well as in the epidermis. The microsporon, termed epidermophyton by Bazin, is the parasitic fungus of pityriasis versicolor. Both the latter are members of the group of torulaceæ. *See* Epiphytic Skin-Diseases; and Aphthæ.

Erasmus Wilson.

EPIPHYTIC SKIN-DISEASES.—Synon.: Tineæ; Dermato-mycoses or Dermato-phytoses; Ringworms; Fr. *Trichophytécs* (Besnier); *Teignes*; Ger. *Flechte.*

Definition.—An *epiphyte* is a living vegetable organism which grows in the superficial parts of the skin or mucous membrane of another organism, and is parasitic—*i.e.* lives at the expense of its host.

Classification.—The vegetable parasites are all fungi and belong to the subdivisions Schizomycetes (bacteria), Blastomycetes (yeasts), and Hyphomycetes (moulds). In addition to the pathogenic microbes of anthrax, glanders, erysipelas, leprosy, tuberculosis, &c., which may occur in the skin in association with these diseases, there exists under normal conditions a number of micro-organisms amongst the scales of the skin and its appendages, in nature between saprophytes and genuine parasites. There is a growing tendency to assume that, under certain conditions, this 'dermatological flora' may possess pathogenic properties. There may also be found from time to time accidental organisms of various kinds, and these are the pyogenic microbes. A parasitic origin has been ascribed to alopecia areata, but not proved; and the ætiological connexion of certain organisms found in furuncles, oriental sore, and impetigo contagiosa, &c., is still unsettled. Lastly, there are the bacteria of bromidrosis and red sweat, and the organisms associated with certain hair conditions, such as tinea nodosa, piedra, and forms of sycosis.

Apart from all such, however, there is the distinct group of Hyphomycetes, achlorophyllous thallophytes, living only on organic carbon compounds and needing oxygen, which constitutes the long-established class of true epiphytic diseases. The group is composed thus:—

1. *Tinea favosa* or *favus*, caused by the *Achorion*, discovered by Schönlein. The phases occurring in the scalp, beard, non-hairy parts, and nails may be specially noted.
2. *Tinea trichophytina* or *ringworm*, caused by the *Trichophyton tonsurans* of Gruby and Malmsten. Here also the phases occurring in the scalp, beard, non-hairy parts, and nails have special characteristics.
3. *Tinea imbricata* or *Tokelau ringworm*, a special (?) form found in Polynesia, and the Malay and Indian Archipelagos.
4. *Tinea versicolor* or *chromophytosis*, caused by the *Microsporon furfur* of Eichstedt.
5 *Erythrasma*, caused by the *Microsporon minutissimum* of Burckhardt.

To this list are usually added *mycetoma* or the fungus-disease of India, due to the *Chionyphe Carteri*; and an obscure disease of Mexico and parts of Central America called *pinta*.

This group of the Hyphomycetes, whose natural history is even yet not fully known, stands apart by itself, but its members are most nearly allied to the Mucorinæ. The difficulty of determining their affinities and classification has given rise to much controversy, now almost subsided. Increased knowledge of their morphology, direct experiment, and successful pure cultures have established that these dermato-mycoses are not due to polymorphic forms of some mould, such as Penicillium, Aspergillus, Mucor, &c., but are distinct species, with different vegetations, growing in a constant and determined form, with different behaviour under attempted cultivation, and always giving rise to similar objective symptoms. Tinea trichophytina, favosa, and versicolor cannot give rise to one another, but breed true. These dermato-mycoses are contagious, and are inoculated from person to person and from animals. Their fungi have no sporangia, but consist of spores and simple or branched, jointed or unjointed, filaments or tubes, which are either mycelial (vegetative) or spore-bearing. The spores become isolated, or are arranged in moniliform threads or in masses. Balzer says, 'Everything is derived from the spore, which by elongation forms a tube or filament of mycelium; in the interior of this tube the substance of the nucleus (*protoplasm*) buds, sends out lateral processes and segments, so as to form the *spore-bearing tube*; when, later on, segmentation of the sheath occurs in its turn and imprisons the segments of the central substance, new spores are thus formed and will evolve, in their turn, in a similar manner.'

Description.—To examine the fungus, some epidermic scales should be scraped, or a hair placed on a slide, and soaked for a time in 20 to 40 per cent. soda, potash, or ammonia solution or in acetic acid. Then the specimen should be gently pressed out by the cover-glass to ensure proper focussing, and examined by a microscopic power of 300 or more diameters. If there is much fat present, the material must be previously soaked in ether. For more accurate and delicate examination, coloration of the specimen is necessary with methyl violet, eosin, or iodine. The erythrasma fungus needs high powers and staining. It is often impossible to name with certainty isolated spores or even filaments of these epiphytes, but when seen in bulk and in connexion with the clinical symptoms, there is rarely any difficulty. Unfortunately there are no elective stains to differentiate them. The abundant *Microsporon minutissimum* is so minute and slender as to be unmistakable. *M. furfur* also is very characteristic, with its roe-like masses of large uniform spores, and its short, much curved pieces of mycelium. The *Achorion* and *Trichophyton* are much more difficult to distinguish apart from cultures, and they differ from the other two epiphytes in attacking the hairs, though achorion does so to a much less extent than trichophyton. Kaposi says achorion displays a predominance of conidia of very variable size and shape, a comparatively short and remarkably jointed mycelium, a scarcity of smooth-bordered tubes, and a facility for breaking up into single cells; trichophyton less numerous, smaller and more uniform conidia, and more tenacious, branched, and smooth-bordered mycelium. In the hair and nails, however, trichophyton forms conidia with the greatest freedom.

Anatomical Seat.—These dermato-phytes flourish in the epidermic tissue—*i.e.* the epidermis, hairs, and nails. We know little of many of the conditions of the soil favourable or otherwise to their growth. Achorion and trichophyton prefer the skin of the young and such as grows fine hair. These fungi are more likely to attack and flourish in uncared-for children, and hence the prevalent idea that ill-health or dirt are essential factors. A certain degree and combination of moisture and temperature are favourable, as exemplified by the affection of calves after being shut up in winter quarters, and by tropical ringworm.

Effects.—The effects which epiphytes produce are, firstly, to mechanically dissociate and thus destroy the epidermic cells, on the nitrogenous products of which they live; and, secondly, to cause local inflammation, chiefly in all probability by the formation of irritating chemical substances. The degree of inflammation excited varies for each fungus and with different individuals; and it is difficult to determine the relative parts played by individual susceptibility, and the powers of irritation possessed by the fungus under the different conditions of its source of origin, the character of the nutrient medium, &c. The inflammation may be evidenced only by hyperæmia and desquamation, or by exudation and the formation of papules, vesicles, pustules, &c. As the fungus tends to grow equally in all directions, a rounded area of inflammation is formed, which subsides in the older central parts, so that a *ringed eruption* is commonly produced.

The general health is not perceptibly affected by any absorption of the products of fungus-growth, nor is there evidence of any auto-vaccination preserving from a second attack.

These dermato-mycoses are inoculable from human beings and some lower animals directly, and by means of infected caps, towels, brushes, razors, clothes, &c. Their course is usually very chronic, but the soil may become exhausted and unfavourable.

Diagnosis.—The diagnosis, when the clinical symptoms are well-marked, is clear; but scientifically, and even practically at certain stages, it is necessary to search microscopically for the fungus.

Prognosis and Treatment.—The *prognosis* depends on the site affected and the nature of the fungus; but the dermato-mycoses are all amenable to *treatment* by parasiticides and the mechanical removal of the fungus. Great inconvenience and annoyance, however. are occasioned, and sometimes disfigurement. *See* Tinea tonsurans; Tinea versicolor; and Favus.

T. Colcott Fox.

EPIPLOITIS (ἐπίπλοον, the omentum). Inflammation of the epiploon or great omentum. *See* Peritoneum, Diseases of.

EPISPADIAS (ἐπί, upon; and σπάω, I tear).—A malformation of the penis, in which the urethra opens on its upper surface. *See* Penis, Diseases of.

EPISPASTICS (ἐπί, upon; and σπάω, I draw).—Substances which, when applied to the skin, are capable of producing a blister. *See* Counter-irritants.

EPISTAXIS (ἐπί, upon; and στάζω, I drop).—Synon.: Fr. *Épistaxis*; Ger. *Nasenbluten.*

Definition.—Epistaxis signifies a bleeding from the nose.

Ætiology.—Epistaxis is either *traumatic* or *idiopathic.*

The *traumatic* form may be occasioned by a blow, by violent sneezing, by snuffing up irritating substances, or by direct violence; but in these cases there frequently appear to be general or local *predisposing* causes to account for the readiness with which it occurs, such as a hæmorrhagic diathesis, an inflammatory or congestive hyperæmia, or some ulceration of the mucous membrane.

The *idiopathic* form of epistaxis frequently occurs in children, particularly boys, just before or about the age of puberty, and in girls as a form of vicarious menstruation. Epistaxis may be one of the forms of bleeding in persons of hæmorrhagic diathesis, in which case it is a source of anxiety and difficulty. Occurring in advanced life, it may be indicative of over-distension or obstruction of the cerebral venous system from chronic Bright's or cardiac disease; and the blood which flows is then often venous in appearance. Occasionally it occurs as a spontaneous relief to determination of blood to the head, in which form the blood generally proceeds from one nostril only. In other instances epistaxis is connected with serious disorder of the blood, as in the specific fevers. Thus it is often associated from the outset with remittent, enteric, typhus, or scarlet fever, and is indeed regarded in some degree as pathognomonic of enteric fever. It may also attend scurvy, purpura hæmorrhagica, splenic disease, pyæmia, and erysipelas, being a consequence of the septic condition.

In its passive form, epistaxis may be associated with organic disease of the heart, pleurisy, emphysema; or with ascites or ovarian dropsy, on account of pressure on the diaphragm inducing a stasis of the venous circulation. It may occur spontaneously from exposure either to great cold or great heat, or a sudden change from cold to heat, or from the diminution of atmospheric pressure, as in going up high mountains.

Symptoms.—Hæmorrhage from the nose is too familiar to demand description in this place. The flow of blood may be either continuous or drop by drop. As a rule, the escape of blood is from one nostril, bleeding from both being rare. It may last a very short time, or for some hours, and in severe instances for days, causing syncope, or even being attended with fatal results. It is at times met with as occurring periodically.

Diagnosis.—Epistaxis must not be confounded with hæmoptysis, as may happen if the epistaxis takes place posteriorly, and the blood passes into the mouth.

Treatment.—When epistaxis is obviously a salutary process, as it undoubtedly is in a good many instances, it subsides spontaneously; where it occurs frequently and severely, recourse must be had to mechanical, cutaneous, or internal remedies. The local application of cold, in the form of cold-water or iced compresses to the nose, neck, or forehead is most useful, acting as these agents do either directly or by inducing a reflex effect on the vaso-motor nerves. Simple pressure upon the nostril, or upon the septum nasi, by compressing the bleeding nostril with the finger of the opposite hand, while the arm of the affected side is raised above the head, is the most readily practicable and effectual of all measures. The application of mustard over the stomach or upon the ankles is sometimes successful. When simple means fail, astringents, either in the form of solution or powders, may be injected into the cavities, or applied on plugs of lint or cotton-wool; such as alum, acetate of lead, the salts of iron, or gallic or tannic acid.

Internally, the frequent administration of saline purgatives, tincture of perchloride of iron, turpentine, bromide of potassium, belladonna and quinine, ergotin (subcutaneously), sulphuric acid, or acetate of lead, may be necessary in cases of periodic attacks.

In very severe cases the operation of plugging the nares, and thereby favouring the formation of a clot, must be resorted to; and the most ready and easiest method is by the employment of Bellocq's sound, or, more properly, cannula. If, however, this instrument be not at hand, a catheter or an eyed probe should be threaded with a stout silk or hemp ligature, and pushed along the floor of the nose until it protrudes beyond the velum palati; one end of the thread should now be pulled out of the mouth by the fingers or forceps, and a roll of lint or a piece of sponge tied to it, and then pushed up behind the velum. The catheter and the attached thread being now withdrawn through the nostril, the plug is pulled forcibly against the posterior nares, and by the pressure exerted the hæmorrhage can generally be arrested. The intra-nasal plug is invaluable. It consists of a thin indiarubber bag, connected with a tube provided with a stopcock. The bag is passed empty along the floor of the nose into the nasal fossæ, and then blown up or filled with water. Transfusion is indicated in very severe cases, where there is danger of delay. The strictest antiseptic precautions should be used in 'plugging'—such as puffing with iodoform, or syringing with the various antiseptics, as it not infrequently happens that the condition known as ozæna commences after severe cases of epistaxis.

Edward Bellamy.

EPISTHOTONOS (ἔπισθεν, forwards; and τείνω, I extend).—A synonym for emprosthotonos. *See* Emprosthotonos.

EPITHELIOMA (ἐπί, upon; and θηλή, the nipple (the word 'epithelium' being at first used for the tissue covering the nipple); and *oma*, a termination indicating a tumour).—Synon.: Epithelial Cancer; Cancroid; Fr. *Epithélioma*; Ger. *Epithelkrebs.*

Definition.—Cancerous disease of the skin and mucous membranes, caused by growth inwards of the epithelial cells of the rete mucosum and of the mucous membrane, leading to destruction of connective tissue and progressive ulceration.

Ætiology.—Epithelioma is a disease of advanced age, occurring mostly after forty, although it is found occasionally in young, and, rarely, in very young, individuals. It is more common in men than in women, and is usually considered hereditary.

The frequency with which it begins in a wart, shows that certain histological conditions of the skin predispose to its development. The exciting cause is often to be found in local irritation, of which a striking example is seen in the frequency with which cancer of the lower lip in men is caused by the tobacco-pipe. Cancer caused by soot gives rise to chimney-sweep's cancer. It may develop in chronic ulcers, in lupus, in syphilitic scars, and in cicatrices. The irritation of bad teeth may cause it on the cheek. In Cashmere, where braziers are frequently applied to the abdomen and thigh, epithelioma occasionally results. Leukoplakia of the mouth in certain cases ends in cancer. Three cases have been reported in which it developed in warts growing on the hands of persons employed in tar and petroleum works. It may be set up by the irritation of old-standing eczema. In Kaposi's disease a great number of cancerous epitheliomatous ulcers develop in the skin, following the deposition of patches of pigment. Four cases have been reported in which epithelioma developed in old-standing psoriatic patches. It is, however, abundantly proved that chronic irritation of the most various kinds may, in certain persons, result in producing epithelioma; but in what the predisposition consists, or in what way the irritation produces the epitheliomatous growth, are questions upon which no light has yet been thrown.

Description.—In the early stage of epithelioma of the skin the affected surface is found to be hard, more or less nodular, and characterised by small, closely-set, irregularly defined papules which are covered with epithelial scales. These scales are constantly being shed and re-formed; and if the detached epidermis is removed, a red granular surface is exposed. The thickened and elevated area gradually enlarges, forming a superficial hard tumour, which is raised above the level of the surrounding skin, with an abrupt margin. For some time the tumour moves with the skin in which it has grown; but, as it extends, it becomes fixed to the underlying tissues, and a growth is formed, which may either be of very limited extent, or may involve an area of considerable size. Eventually the growth ulcerates; or ulceration may occur so early that the initial indurated stage may not have been noticed, and the first morbid appearance that attracts attention is a small, dry, yellow or blackish crust covering a fissure in the epidermis.

Not infrequently the first development of epithelioma is in a warty growth which becomes fissured after having remained of a simple nature for a long period of time. The wart finally indurates, then ulcerates, and a typical epithelioma is the result.

The *epitheliomatous ulcer* has usually an uneven surface, and is irregularly bounded by hard, livid, everted edges. It is covered by minute granulations or by a greyish crust, which after removal is quickly renewed. It discharges a thin, scanty, sanious ichor, which is usually inoffensive; and it bleeds easily when touched. In some cases there is very little or no pain. In other cases the pain is severe and lancinating, or there may be stinging or pricking sensations, which cause frequent scratching and consequent irritation. The ulcer is usually round, oval, or elongated. Its essential character is the hardness of its borders and base, which is produced by the infiltration which is an invariable feature of the disease. The indurated boundary can be felt as a distinct mass adherent to the subjacent tissues. The borders are generally raised, sinuous, or nodulated, frequently everted, and sometimes undermined. The surface of the ulcer is concave, unequal, nodular, or warty. As the disease progresses, the ulceration extends in depth, and causes destruction of the subcutaneous tissues, muscles, and bones. Whilst ulceration and destruction are proceeding in the centre, the small papillary nodules with a scaly surface, which mark the early stage, are found on the circumference of the sore, and they may increase till they form small tumours before being finally involved in the extension of the ulceration.

In course of time the lymphatic glands corresponding to the affected part become enlarged, being felt at first as small, hard, movable, isolated tumours producing little inflammatory reaction. As they increase in size they become incorporated in a single, somewhat lobulated mass, which eventually softens. From the infected glands the disease may extend further towards the trunk, but more frequently the proximate glands alone become cancerous. The affected glands may inflame, suppurate, and lead to cancerous ulcers, in which the peculiarities of the disease are reproduced. Secondary epitheliomatous growths are occasionally, but not frequently, found in the internal organs.

In the earlier stages of an epitheliomatous growth the destruction may take place chiefly in the corium, in which case the growth is not much elevated above the normal level of the skin. If, however, development takes place chiefly in the papillary layer, we have a permanent and warty growth, whilst if it grows freely in the subcutaneous tissue we have a deep-seated, flat, or rounded mass. These different varieties may more or less intermingle, and thus in the earlier stages of an epithelioma we may have a variety of appearances. This depends to some extent on the anatomical peculiarities of the part in which the disease develops. In all cases before ulceration takes place the affected part is unusually hard and enlarged. The lip, for example, pouts and projects like one overgrown.

The chief varieties of epithelioma are the *superficial* and the *deep-seated* forms, which respectively depend on the greater or less resistance opposed by the *pars reticularis corii* to the extension inwards of the epithelial growth. If the morbid epithelium be for a long time unable to penetrate the strong, firm bundles of the corium, and contents itself with 'cropping off,' as Erasmus Wilson has expressed it, the highly organised *corpus papillare*, we have a typical superficial form which, whilst it extends on the surface, makes an effort at healing in the centre. The disease presents the appearance of an extending cicatrix somewhat like that of a burn, the centre appearing to be healed whilst the advanced border which surrounds the cicatrix is in a state of slow ulceration. But when, either from the greater destructive power of the cancerous epithelium or from weakness of the fibrous tissues of the corium, the growing epithelium pierces the *pars reticularis*, the clinical aspects are much more serious, and are very different. The growth having once penetrated into the subcutaneous tissue, extends, usually with comparative rapidity, producing the destruction which is characteristic of deep-seated epithelioma. When the chief feature of the epithelioma is a projecting papillary growth, we have the so-called *papillary epithelioma* or *malignant papilloma*. This form is not infrequent when the disease develops in a wart. It may have begun as a papilloma or a papillary growth, or may develop subsequently on a superficial or more frequently on a nodulating, ulcerating epithelioma. It may project considerably above the level of the surrounding skin, and may be seated either on a broad base or have a constricted neck, assuming a fungating form. The surface is formed of cicatrices and enlarged papillæ, which are cylindrical, pyriform, or conical, and single or in clusters. They are very vascular, the surface chiefly covered with an opaque, white cuticle, of a pink, vermilion, or brightly florid hue. When the loose epidermic scales are washed off, we have the granulated and lobulated surface known as 'cauliflower-like excrescence.' The epithelial cells may contain melanotic matter, which is also found between the cells, and we have then *melanotic epithelioma*. In *discoid epithelioma* there is a sharply bordered circular or oval disc, the margins being bounded by healthy integument, which is raised and slightly everted by the growth.

An epithelial cancer may grow up in the form of a cone, although such cases are rare. Sir James Paget removed one from the lower lip half an inch high, and nearly as much in diameter at its base, and another in a chimney-sweep's neck of a similar kind. In both cases the growth was covered with a thick laminated scab, not easy at first to distinguish from syphilitic rupia. Mr. Henry Morris has seen one in the outer dorsum of the foot in a man aged fifty-six. Or the growths may even be pendulous. Sir James Paget refers to growths on the lower lip and anus consisting of masses of very firm granulations far overhanging the adjacent healthy skin.

The tendency in all these forms is to produce continued destruction of healthy tissue, unless the morbid growth is removed by operation. In the later stages of the malady exhaustion supervenes, and the patient eventually succumbs, worn out by pain and increasing discharge from the ulcerating surface.

SEATS.—Epithelioma may develop at any part of the integument, but is most frequent on the *face*. In 102 cases 78 were on the face, 48 of these being in the lip, 4 were on the extremities, and 10 on the mucous membrane of the mouth. The local ravages may be very extensive before they cause death, and in the face may produce hideous deformity, laying bare the bones, teeth, and fauces, destroying portions of the skull until the dura mater is exposed.

The *lower lip* is a very common seat of epithelioma, which commences there either as a warty growth, or as a fissure from the edges of which the disease spreads. The whole lip becomes thickened and hard, projecting outwards, and allowing the saliva to flow from the mouth. The surface ulcerates progressively; and if the affected tissue is not removed, the disease extends to the mucous membrane of the cheeks, giving rise to ulceration, and eventually the throat and bones become affected.

In the *penis* epithelioma may commence as a nodular swelling of the prepuce, or as a hard scirrhous infiltration of the glans, or between the prepuce and glans. In the latter case a discharge may be the first symptom observed. A tight prepuce and phimotic condition of the parts favour the development of the disease. In epithelioma of the glans and sulcus there early occurs thickening of the dorsal lymphatic vessel of the penis, which can be felt as a thick, hard, nodulated tract extending towards the pubes, to be continued towards the inguinal glands, which enlarge into hard, nodulated masses. Abscess and ulceration eventually occur.

Primitive epithelioma of the *vulva* frequently develops as a small warty tumour ; at other times it is preceded by pruritus or a long-standing leukoplakia. The point of origin is not infrequently on the mucous surface of the labium majus, or at the junction of the skin and mucous membrane. There is usually a discharge of bloody, ill-smelling serum. A tumour may form as large as a nut or hen's egg, with a hard, shining, papillated surface. It may or may not be pedunculated. The labium minus may be the seat of infiltration of a hard consistence and reddish colour, and there may be a tumour, more or less pedunculated, of the clitoris. After the first symptom of pruritus there is a sensation of cold and fulness of the pelvis, especially in walking or standing. The progress is usually slow. At the beginning, epithelioma of the vulva may be mistaken for chronic granular vaginitis, or non-malignant tumour, and in the ulcerative period for a primary syphilitic sore or a gumma. The severe lancinating pains and extension of the ulceration remove the doubts which may have existed during an earlier period.

Epithelioma of the *anus* is rare. It occurs as a notched and protuberant growth at the anal orifice, and extends into the gut.

In the *limbs*, usually the leg, epithelioma mostly develops in cicatrices, varicose ulcers, syphilis, and lupus.

Epithelioma of the *mucous membrane* of the nose, conjunctiva, vagina, and rectum may appear either primarily, or secondarily as an extension from the adjacent skin. Cancer of the tongue and mucous membrane of the cheek is not uncommon, in which situations it may develop on the seat of syphilitic change, or on a patch of leukoplakia. On the tongue it begins as a raw granulated surface, which is sometimes thickly set with white points, tender to pressure ; and it may bo the seat of pain, nodular infiltration developing under the sore. Sometimes the nodular infiltration precedes the ulceration. On the mucous membrane of the cheek epithelioma is rarer, and is generally flat but sometimes fungoid when it occurs.

Anatomical Characters and Pathology. The pathology of epithelioma may be summed up briefly in describing it as an epithelial neoplasm, which leads to the destruction of the vascular tissues amongst which it grows. From the rete mucosum there occur offshoots of epithelial growth, which travel along the papillary layer, pierce the corium, and (wherever they grow) produce, in the first instance, well-marked developments of inflammatory action. Wherever the epithelioma comes in contact with the vascular tissue, it acts like a poison, and evidences of destruction are found. The essential feature is not that there is a new growth of epithelium, but that there is a growth of a new kind of epithelium, which is, in effect, a connective-tissue poison. Like all poisons, this epithelial poison exerts an irritating influence on the adjacent blood-vessels, as is witnessed by abundant small cell infiltration, serous effusion, redness, and other evidences of engorged blood-vessels. Cancerous epithelium has then two abnormal qualities: one in that it grows inwards into the connective tissue ; the second, that wherever it grows it produces inflammatory action. When a vertical section is made through the edge of an epitheliomatous ulcer, we find on the outer border which is adjacent to the healthy tissue prolongations inwards of the rete mucosum, whilst in the connective tissue of the papillary layer and cutis we find sections of apparently isolated masses of epithelial growth. These isolated masses, which are mostly in a cylindrical form, were really in unbroken continuity with growths from the rete ; but as the growths, after they have penetrated downwards, follow to a certain extent the lines of least resistance, they cease to be in a direct line with the interpapillary cone from which they have come, and therefore, in a thin section, appear to be detached. It is this apparent isolation that led to the erroneous interpretation that epithelial cancer was caused by a heterologous growth of connective-tissue corpuscles. That in cancerous tissue the epithelium takes its origin in the rete mucosum is a fact that was recognised so long ago as 1852 by Hannover, but was lost sight of for many years after Virchow's views on cellular pathology became generally accepted. It was again clearly shown by Thiersch in 1865.

There is a special epithelial physiognomy peculiar to the morbid growth in each individual case. In many instances the cell columns undergo an extreme degree of horny change, and we find in the sections groups of very large horny cells clustering concentrically, giving rise to the so-called laminated capsules or 'nests.' In some cases the cell-columns do not take on the extreme horny metamorphosis, all the cells retaining the ordinary apparent characters of rete cells.

The large horny cells frequently break down, and in their cavities numbers of nuclei are found, an appearance which has suggested the theory of so-called 'mother' and 'daughter' cells. The appearance is, however, equally in harmony with the probable theory that leucocytes have found their way into the interior of the broken-down cells.

The new cells are generally supposed to be formed by cell-fission—a process, however, which is not found when sections are examined. Whatever the exact method may be by which this epithelial growth takes place, there is no reason to believe that in principle it differs from that which is characteristic of increase of epithelium in healthy conditions.

When the changes in the connective tissue which lead eventually to ulceration are carefully scrutinised, it is found that under the influence of the epithelial poison there is an extensive emigration of white and red corpuscles, a splitting up of the bundles of connective tissue into the primary or elementary bundles of which they are composed, and eventually disintegration of the bundles altogether, a granular detritus taking their place. Immediately under and bounding the ulceration, masses of small cells are found, numbers of engorged and dilated blood-vessels, and many free blood-corpuscles.

The diseased epithelium not only possesses the power of destroying the connective tissue, but finds its way into the lymphatic vessels, and by them into the lymphatic glands. Occasionally it is conveyed into the viscera, leading to cancerous deposits in the internal organs.

Attempts to associate cancerous developments with the presence of micro-organisms have not yet been confirmed. Dr. Yakimoff has stated that in cancer the blood-vessels, not only near the tumour but throughout the body, acquire thickened walls with diminished lumen. Mr. Ballance and Mr. Shattock have described in cancerous tissue, after sterile incubation, a projection of nuclear granules into the cell protoplasm, and they suggest that the stimulus which excites the epithelial growth may be due to these particles.

Diagnosis.—Before ulceration has taken place it is possible in the early stage to confound epithelioma with sebaceous *acne*, with *warts*, and with certain forms of *lupus*. If in acne sebacea the crusts on the affected part are removed, by rubbing with soft soap or other means, a healthy skin with distended sebaceous follicles is laid bare, the disease not extending deeply into the true skin. In distinguishing between epithelioma and lupus, it is to be borne in mind that in lupus the patient is, as a rule, either young or has a history of having suffered from the disease in early youth. In lupus the characteristic infiltration will be found on or near the borders of the affected part. In an ulcerating lupus the edges of the ulcer are soft and regular and not everted. The ulceration extends more on the surface than in depth. It must not be forgotten that epithelioma may develop in the seat of lupus.

A *tubercular syphilide* is distinguished by the colour and grouping of the tubercles, which are multiple; whilst epithelioma begins usually by a single tubercle, runs a slower course and lasts longer, and is not affected by a course of iodide of potassium. The diagnosis between epithelioma and syphilis is sometimes difficult, and without microscopical examination is occasionally impossible. Syphilomata presenting this difficulty are not infrequent on the tongue and lower lip, the diagnosis being rendered difficult by their late appearance, and often by their long period of latency. In such cases it is of great importance that a small portion of the affected surface should be excised and subjected to microscopical examination. In syphilitic ulcers the ulceration progresses usually more rapidly than in epithelioma. The ulcers are multiple, whilst in epithelioma the ulcer is usually single. Whilst the tissues surrounding the epitheliomatous ulcer are infiltrated and hard, in syphilis the diseased surface is usually bounded by apparently healthy skin. The pain which is frequently present in epithelioma is not usually present in syphilis, and when it is present it yields to palliatives.

It may be difficult to distinguish between a *simple wart* and an epithelioma which begins in a warty growth. If a tumour of this kind develops in an elderly person, shows a tendency to spread, and is the seat of frequent desquamation with excessive formation of epidermis, the probability is in favour of epithelioma.

It is sometimes not easy to distinguish epithelioma on clinical grounds alone from *rodent ulcer*, which is a form of superficial cancer depending on a specific epithelial cell. A typical epidermic epithelioma and a typical rodent ulcer can be distinguished; but there are cases in which, without microscopical examination, the diagnosis for a time is impossible. Rodent ulcer produces less inflammation in the surrounding tissues, and usually after ulceration occurs; it takes place at first slowly and superficially. If the glands become affected we may feel confident that we are dealing with an epithelioma. Either of these forms may occur on any part of the body, but in the majority of cases epithelioma occurs on the lip, whilst rodent ulcer is found on the upper part of the face. The rolled-over edge, which is frequent but not constant in rodent ulcer, is very characteristic. *See* Rodent Ulcer.

Prognosis.—The prognosis in epithelioma of the skin is not so grave as that in other forms of cancer, because its course is slow, and because it is frequently well within reach of radical treatment. If removed sufficiently early and completely it will not return at all. Metastasis is rare. The gravity in any special case depends upon whether the ulceration remains localised on the surface or penetrates deeply. In the deep-seated form the danger to life is considerable. The disease may last a long time before the health becomes seriously affected. Unless, however, relieved by successful treatment, the patient's strength eventually fails, the characteristic pain of cancer increases, and death usually takes place from exhaustion; sometimes from hæmorrhage caused by blood-vessels being exposed in the progress of the disease.

Treatment.—No medicines administered internally have any effect on this disease; but so long as the new-growth remains single and is within the reach of surgical treatment, we may hope for a successful result. As soon as the nature of the growth is ascertained, the whole of the diseased tissue should be removed, where this is possible, either by the knife or with caustics. The surgeon will naturally, when it is possible, have recourse to a cutting operation; and where the ulcer has attained a certain size and there is considerable infiltration present, complete excision of the whole of the diseased tissue is a very effectual method of dealing with the disease. In the early stages of the affection there is no doubt that it is within the reach of caustics. An epithelioma in a limited warty condition may, when the affected surface is small, be successfully treated in this way after scraping with a curette. In severe cases, too advanced to be reached by the knife, the progress of the disease may sometimes, to a certain extent, be arrested by cauterisation, under which the condition of the ulcerated surface improves, pain is diminished, the discomforts of the patient's condition lessened, and life prolonged. If the knife is used, it is necessary to cut well beyond the affected tissue, as there is little doubt that relapses, when they do occur, are due to the fact that a nidus of infected cells has been left behind, although they had not developed sufficiently to enable the surgeon to recognise the extent to which the disease had spread. We have found by microscopical examination of excised epitheliomata, that sections from the part next the line of incision have contained cancerous epithelium between the connective-tissue bundles.

The caustics generally used are caustic potash, chloride of zinc, pyrogallic acid, and arsenic. Caustic potash may be used either in stick or in solution. It has the advantage of being thorough in its action, and of not leaving much pain after it has been used. The growth, of course, should be thoroughly cauterised. Pyrogallic acid is used as a 10 per cent. ointment, which is spread on linen and kept continuously applied for from three to six days. It is less painful than chloride of zinc. Chloride of zinc is used as a paste in the proportion of one part to three parts of gum mixed with a little water. The paste is laid over the diseased surface, which must be blistered if the skin is entire, the surrounding healthy skin being protected by adhesive plaster. A strip of plaster cover should be placed over the whole. The paste will destroy structures equal to three or four times its own thickness. The zinc paste which is used at the Middlesex Hospital is composed of equal parts of chloride of zinc and liquor opii, with sufficient flour to make it into a paste. Resorcin has been recently recommended for epitheliomata. There are cases in which it answers well; in other cases its action does not seem sufficiently energetic. The writer has used it as incorporated in Beiersdorf's (Hamburg) gutta-percha plasters, aiding its action by painting the surface with a solution in alcohol. The treatment is comparatively painless, and interferes little with the comfort of the patient. Lactic acid has also been recommended for epithelioma. It is supposed to have a destructive effect on the diseased tissue, whilst it spares the healthy structures; but the alleged advantages have not yet been sufficiently confirmed.

Amongst the various caustic pastes which have been used in epithelioma arsenical paste, as regards efficiency, occupies a high place, although, on account of the danger attending absorption, it requires special care. The writer cannot speak from his own experience; but he has the testimony to the merits of the paste recommended by Dr. Marsden of his friend Dr. MacLaurin of Sydney, who has used it extensively in hospital and private practice, and is satisfied that for a considerable number of cases it possesses very great advantages.

G. Thin.

EPITHELIUM, Diseases of.

—The different kinds of epithelium must be separately considered, as they differ in their pathological relations — namely, *squamous* and *cylindrical* epithelium of mucous surfaces; *serous* epithelium, or *endothelium*; and finally *spheroidal* or *glandular* epithelium. The last kind will be better treated of under the heads of the several glands.

A. Diseases of Squamous and Cylindrical Epithelium. — 1. **Catarrhal Inflammation.**—Both varieties of epithelium occurring on mucous surfaces are subject to inflammation, which usually takes what is called the catarrhal form.

Catarrhal inflammation is characterised by hyperæmia, swelling of the tissue, rapid production and casting-off of cells, and increased production of the normal mucous secretion of the parts, without the production of any coagulable exudation, or any layer of new material. The cells thrown off are partly epithelial, partly leucocytes or pus-cells. The secretion contains mucin. The proportion of the various factors of catarrhal inflammation varies greatly, sometimes hyperæmia with swelling, sometimes cell-production, sometimes fluid secretion predominating; and these differences sometimes mark different degrees or stages of the inflammatory process. When the number of leucocytes thrown off is very large, the catarrh becomes purulent, which differs only from the other in degree. Catarrhal inflammation is the ordinary result of irritation applied to a mucous surface ; but it persists after the irritation has ceased, and has a marked tendency to become chronic. While the chief share in producing and maintaining the phenomena of catarrh must be referred to the condition of the blood-vessels which keeps up the congestion, and allows increased transudation and copious emigration of leucocytes, the part played by the epithelial cells in these processes is a point of great interest and importance, though as yet imperfectly determined. These cells, whether squamous or cylindrical, enlarge and alter in shape, sometimes containing vacuoles or mucous drops ; while there must be (since so many are shed) a rapid new formation of them ; but the seat of this new formation, whether in the normal or the pathological condition, is still obscure. All that can be clearly seen is that new epithelial cells grow up from the basement membrane by the side of the old ones. Further, it is not unusual to find swollen epithelial cells which show division of the nuclei or partial division of the cell itself, and others which show within their substance several smaller, roundish bodies, with the general character of young cells. These appearances have been regarded as indicating (1) multiplication of cells by fission, (2) endogenous cell-formation within the mother-cells, and (3) the origin of the numerous pus-corpuscles seen on the inflamed surface. There is, however, no reason for thinking that new epithelial cells, or still less that pus-corpuscles, are formed in this way. The presence of pus-corpuscles or young cells within the epithelial cells is probably an accidental complication, the young cells which possess the power of migration being absorbed into the protoplasm of the epithelial cells, so as to appear as if originally formed there. The production of vacuoles or mucous droplets in the epithelia appears to show an abnormally rapid production of mucus, and indicates also the death of the cell producing it. It is, therefore, an evidence of excessive mucous formation, and explains also the rapid desquamation of the mucous epithelium.

2. **Croupous Inflammation.** — Croupous inflammation is distinguished by showing, in addition to hyperæmia and swelling, the production of a layer of new material, or false membrane, easily detached from the surface. This form is usually, if not exclusively, seen on surfaces covered with cylindrical epithelium, as in the air-passages. The false membrane, composed of fibrin cementing together layers of detached epithelium and leucocytes, does not owe its origin to any alteration of the epithelium itself.

Croupous inflammation of epithelial surfaces has been regarded as always indicating some specific form of inflammation. It now appears, however, that it may be produced by simple irritation, such as that which produces the catarrhal form, provided the irritation be sufficiently intense and destroys the superficial epithelium.

3. **Diphtheritic Inflammation.**—This is a name used with much variation of meaning, but generally to signify a process in which there is production of a false membrane closely adherent to the epithelial surface, and which is accompanied by some degree of necrosis or gangrene. In the production of the diphtheritic false membrane an important part has been assigned to the epithelium, it being held that the new material, which appears like exuded fibrin, is really produced by a metamorphosis (the so-called *fibrinous transformation*) of the pavement epithelium. It is pretty clear that when this condition occurs on surfaces covered with this variety of epithelium some such change in the epithelium does take place, but not that the membrane is made up wholly or even in any large degree of such altered cells. Moreover, even this cannot be clearly traced on surfaces covered with cylindrical epithelium. The membranes consist in large measure of cast-off epithelium, and also (as the writer holds) partly of fibrin, though the presence of the latter constituent is denied by some authors. It should be noted that the terms croupous and diphtheritic inflammation, as here used, are not synonymous with the diseases named croup and diphtheria. Micro-organisms, either micrococci or bacilli, especially the former, are always found in the diphtheritic false membrane. Some may be regarded as mere saprophytes, living in the dead tissues; but there is apparently at least one species, possibly more than one, capable of originating the morbid process, and causing necrosis of the epithelium. *See* DIPHTHERIA.

4. **Fatty Degeneration.** — It is very common to find the protoplasm of both squamous and cylindrical epithelial cells dotted with oil-globules, so much so that this must be considered normal, to a certain extent, in some glandular epithelium (as kidney), and does not appear to interfere with the function of the cells. When the fatty change, however, is extensive, and more especially when the whole body of the cell is opaque, the condition must be regarded as one of fatty degeneration (*see* FATTY DEGENERATION). This is seen in the stomach in cases of alcoholism, in poisoning with metals or phosphorus, and in cases which are probably nothing more than chronic catarrh. It is also seen in the alve-

olar epithelium in pulmonary emphysema. Fatty degeneration in epithelium appears to be a process leading to atrophy or destruction.

5. **Mucous or Colloid Degeneration.** Epithelial cells, especially in parts which are naturally adapted to the production of mucus, particularly cylindrical epithelium, are liable to undergo a form of degeneration in which a portion of their protoplasm becomes converted into mucous substance, and thus liquefied. Cells having this character are often seen in catarrhal conditions of the mucous membrane of the air-passages, but the change is probably only an exaggeration of the physiological production of mucus in the interior of the cell. It has not been traced in squamous epithelium.

6. **Albuminoid (Waxy or Amyloid) Degeneration.**—This form comparatively rarely affects epithelial cells, but still in cases of albuminoid disease we may sometimes find that the mucous surface of the intestines is stained with iodine in the characteristic manner. In one or two cases the writer has observed a similar change in the surface of the pelvis of the kidney, and even the bladder, where there has been albuminoid disease of the kidney.

B. Diseases of Endothelium.—The single layer of flat epithelium found on serous surfaces, now generally known as *endothelium*, differs also in its pathological relations.

1. **Catarrhal Inflammation.**—This is unknown on serous membranes, their characteristic form of inflammation being exudative and fibrinous, corresponding thus to the

2. **Croupous Inflammation** of mucous surfaces. In this inflammation the endothelium does not necessarily take any part; though when the inflammation is once established, the endothelium, in part, is simply shed, in part shows changes of a proliferative kind; cell-division, multiplication, and endogenous cell-formation being observed here with less ambiguity (as it appears to the writer) than in the epithelium of mucous surfaces. Similar changes appear to occur in chronic inflammation of serous surfaces, and to play an important part in the production of fibrous adhesions between opposing surfaces.

3. **Fatty Degeneration.** — Endothelial cells are also subject to fatty degeneration, which may be very clearly seen in surfaces macerated by a collection of fluid, as in serous effusions of the peritoneum or pleura.

The other pathological changes of endothelium have not been studied.

The epithelium (or endothelium) lining the inner surfaces of the walls of arteries and veins closely resembles the endothelium of serous surfaces. It is very subject to fatty degeneration, as may be seen on examining atheromatous arteries. A distinct fatty degeneration of this tissue also occurs quite independently of atheroma, or of any inflammatory process. Proliferative changes have also been traced by some observers in the process of occlusion of ligatured arteries or veins obstructed by thrombosis; but they do not appear to play any important part in idiopathic disease.

C. Diseases of Glandular Epithelium.—The diseases of glandular epithelium are best spoken of under the head of diseases of the several glands. *See* Breast, Diseases of; Salivary Glands, Diseases of; &c.

J. F. Payne.

EPITHEM (ἐπί, upon; and τίθημι, I place). A general term for a class of external applications which are soft and moist, such as poultices and fomentations. *See* Fomentations; and Poultice.

EPIZOA.—*See* Entozoa.

EPULIS (ἐπί, upon; and οὖλον, the gum). *See* Mouth, Diseases of.

EQUINIA (*equus*, a horse).—A synonym for glanders. *See* Glanders.

ERETHISM (ἐρεθίζω, I irritate).—A condition of excitement or irritation, affecting either the whole system or a particular organ or tissue. The word has been especially applied to the condition of the body in the early stage of acute diseases, and also to that induced by the too free use of mercury (*mercurial erethism*). *See* Mercury, Poisoning by.

ERGOTISM.—Synon.: *Morbus cerealis*; Fr. *Ergotisme*; Ger. *Ergotismus*; *Kriebelkrankheit.*

Definition.—A disease due to the action of ergot.

Ætiology.—This disease derives its name from the fact that it is the result of the ingestion of ergot—the sclerotium of a fungus called *Claviceps purpurea*, which grows parasitically in the ear of the rye. In some seasons this form of blight affects the grain so extensively that ten per cent. of the meal may consist of ergot. The phenomena to be described as symptoms of ergotism have been regularly and exclusively traced to the use of articles of food made from rye-meal thus contaminated. The appearance and severity of the disease vary with the amount of ergot consumed. Children at the breast are never attacked. Ergotism has frequently broken out in well-marked epidemics, after unfavourable harvests. In ruder times it constituted a severe form of scourge; but now it usually occurs sporadically, or is limited to families or small communities.

Anatomical Characters. — Ergotism is characterised by definite anatomical changes, mainly in connexion with the vessels and the spinal cord. The arterioles are found *post mortem* to be contracted, and to be the seat of a peculiar hyaline degeneration of the intima, with thrombosis and diminution, or even complete disappearance or occlusion, of their lumen. Gangrene is the ultimate result of these morbid changes. The posterior columns of the spinal cord are the seat of a degenerative or sclerosing process, somewhat resembling the lesion so familiar to us in locomotor ataxy.

Symptoms.—Within a few days of the first ingestion of rye-meal contaminated with ergot, the ordinary phenomena of irritant poisoning are developed, namely, vomiting, diarrhœa, severe abdominal pains and cramps, and general depression—giddiness and headache being specially marked.

Along with the preceding, certain specific symptoms gradually make their appearance. The first and most characteristic of these is formication (a sensation of insects running along the skin), attended with severe itching of the extremities. The other special senses, such as vision and hearing, may also become disordered. Occasional tearing pains occur in the limbs, and clonic spasms of the muscles. Ravenous hunger is said to be a striking symptom in some instances. The pulse is infrequent and small. Respiration is not markedly disturbed.

The remaining phenomena peculiar to ergotism are usually described as belonging to two forms, the *gangrenous* and the *spasmodic*, according as the circulation or the nervous system is chiefly affected.

(*a*) *Gangrenous ergotism.*—The gangrene produced by ergot is peculiar only in respect of its cause. The toes, fingers, feet, ears, and nose are the parts most commonly attacked. The incipient discoloration, pain, and swelling are observed within a period of two days to three weeks from the commencement of the other toxic symptoms. The necrotic process passes through the ordinary stages of development; may be either 'wet' or 'dry;' and advances to complete separation of the part, if this have not been previously removed by operation.

(*b*) *Spasmodic ergotism.*—The leading symptom of this form of the disease is the occurrence of severe intermittent cramps or painful spasms, specially affecting the lower extremities. These develop into tonic contraction of the muscles, with fixation of the limbs; and end perhaps in general convulsions, prostration, various kinds of mental derangement, unconsciousness, and death. Abortion does not appear to be of frequent occurrence.

Course, Duration, and Terminations.—Many cases of ergotism are acute rather than chronic; but when gangrene appears, the course may be very protracted and variable. Spasmodic ergotism may last from two weeks to as many months. The mortality is said to have fallen from sixty to ten per cent. In a few cases, resolution occurs in affected extremities.

Pathology.—Beyond its effect as an irritant poison, the specific influence of ergot is mainly exerted upon the organs of circulation, the central nervous system, and the uterus. The different effects have now been satisfactorily traced to the actions of the different organic constituents of the diseased grain.

Cornutine, an alkaloid, one of the four important organic constituents of ergot, produces slowing of the cardiac rhythm by stimulation of the vagus at its central extremity. The contraction and hyaline change of the walls of the arteries are due to the action of a second constituent, sphacelinic acid. The result of these effects on the heart and arteries is that the blood-pressure rises. The gangrene is readily accounted for by the vascular changes, and is thus definitely referable to the sphacelinic acid.

The painful spasms, as well as the formication and other sensory disturbances, are the direct result of the action of the cornutine upon the spinal cord.

The action of ergot upon the uterus is explained by some authorities as due to stimulation by cornutine of the uterine centre in the cord. Other authorities maintain that it is set up by the local anæmia produced by the vascular contraction; whilst others, again, consider that ergot acts directly upon the muscular fibres of the organ.

Diagnosis.—The occurrence of gangrene in a number of young and previously healthy persons, in countries where rye-meal is an article of food, should remove all difficulty from the diagnosis of ergotism. The spasmodic form of the disease can usually be distinguished from epidemic cerebro-spinal fever by the absence of pyrexia.

Prognosis.—The prognosis depends chiefly upon the early recognition and removal of the cause. The probability of the escape of affected extremities may be estimated by the degree to which the gangrenous process has advanced.

Treatment.—The treatment of ergotism must commence with the removal of the cause. An attempt must then be made to hasten the elimination of the poison by the cautious administration of emetics and purgatives; to allay the symptoms of gastro-enteritis; and to support the strength of the patient by internal and external stimulants, such as alcohol, warmth, and friction. The treatment of less acute ergotism, including spasmodic cases, is symptomatic. Gangrene must be averted by careful local stimulation —by means, for example, of warm fomentations; or treated surgically if it make its appearance. *See* Gangrene.

J. Mitchell Bruce.

EROSION (*erodo*, I gnaw).—A superficial destruction of tissue, caused especially by friction, pressure, corrosion, or certain forms of ulceration.

EROTOMANIA (ἔρως, love; and μανία, madness).—Synon.: Love-melancholy; Satyriasis (in men); Nymphomania (in women); Fr. *Monomanie érotique*; Ger. *Liebeswuth.*—Insanity characterised by excessive sexual excitement; sometimes symptomatic of cerebral lesion, sometimes of disorder in the reproductive organs. *See* Insanity.

ERRATIC (*erro*, I wander).—Wandering, shifting, or irregular. Applied to pains, eruptions on the skin, and other morbid phenomena, when they shift or move from place to place.

ERUCTATION (*eructo*, I belch).—Definition.—The sudden escape or expulsion of gas from the stomach upwards, with or without an admixture of portions of liquid or solid food, or of gastric juice or other liquids.

Description.—The act of eructation may be voluntary or involuntary. In the former case a small portion of air is first swallowed, and by the over-distension thus produced the escape of a portion of the gaseous contents of the stomach is favoured. When involuntary, we must suppose that the cardiac orifice, which is closed in the normal state of digestion, is relaxed, and thus permits the rejection of portions of undigested matter. From the violence with which eructations often take place, we may also assume that the muscular coat of the stomach contracts spasmodically at the same moment that the relaxation of the cardiac opening occurs. The nature of the material rejected varies greatly. Sometimes it is tasteless, at other times acid, and in rarer instances alkaline.

Ætiology.—Eructations occur in all gastric diseases attended with an undue formation of gas. They are constantly complained of in atonic dyspepsia, more especially in that form which occurs in elderly people, and are probably the result of an imperfect contraction of the stomach, preventing the due expulsion of the digested food into the intestine. They form a prominent and distressing symptom in dilatation of the stomach. In such cases the patient often complains of a sense of fermentation in his abdomen, and immense quantities of gas are expelled, generally mixed with an acid or acrid fluid.

Treatment.—The indications in the treatment of eructations are to prevent the decomposition of food, and the formation of gases and other products; to restore tone to the stomach, and remove any morbid condition of this organ; and to give remedies with the view of absorbing gases, or assisting the act of eructation.[1] *See* Stomach, Diseases of.

Samuel Fenwick.

ERUPTION (*eruptio*, a bursting forth).—This term is commonly applied to a pathological manifestation in the skin, more or less general; sometimes marked by colour, sometimes by prominence, but more frequently by both. When sudden and hyperæmic, a term derived from the efflorescence of a plant, namely, *exanthema*, is employed, as in the instance of the exanthematous eruptions—scarlatina, rubeola, roseola, and variola. The term is equally applicable to less acute forms of dermatosis, such as urticaria, eczema, impetigo, ecthyma, acne, and furunculus; and is also used for still more chronic forms of disease, for example, psoriasis vulgaris; and for outgrowths of the skin due to aberration of nutrition, as in the instance of warts and molluscous tumours. Erasmus Wilson.

ERYSIPELAS (ἐρυθρός, red; and πέλλα, skin).—Synon.:—Lat. *Erysipelas*; Fr. *Érysipèle*; Ger. *Erysipelas.* Popular names:—St. Anthony's Fire (English); the Rose (Scotch); *der Rothlauf*, and *die Rose* (Ger.)

Definition.—Inflammation of the integument tending to spread indefinitely (*Royal College of Physicians' Nomenclature of Diseases*). The vagueness of this definition indicates the looseness with which the term is employed. The features common to all inflammations usually spoken of as erysipelatous are fever, sometimes apparently preceding the local phenomena; and an inflammation tending to spread indefinitely by means of the lymph-spaces and lymphatic vessels of the affected part.

Summary of Varieties.—Erysipelas is usually divided into: (*a*) *simple cutaneous*; (*b*) *phlegmonous* or *cellulo-cutaneous*; and (*c*) *cellular* or *diffuse cellulitis* (Nunneley). In the first of these the inflammation is seated in the cutis vera, the subcutaneous tissue being often œdematous, but not actually implicated in the morbid process. There is practically no tendency to suppuration in simple cutaneous erysipelas. In phlegmonous or cellulo-cutaneous erysipelas the subcutaneous areolar tissue is primarily affected, but the skin covering the inflamed area is speedily implicated. If not relieved by treatment, the inflammation tends inevitably to diffuse suppuration, often accompanied by extensive sloughing of the cutaneous and subcutaneous tissues. In cellular erysipelas or diffuse cellulitis, deep-seated planes of areolar tissue are affected, such as those of the pelvis. The course of the disease is the same as in cellulo-cutaneous erysipelas, tending to terminate in diffuse suppuration and sloughing. In addition to these three chief varieties, erysipelatous inflammation of the lymphatic vessels and veins, and of serous and mucous membranes, is also described.

Ætiology and Pathology.—All these affections grouped together as erysipelatous belong to the class of infective inflammations;

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[1] Hepatic disorder frequently requires attention, with remedies directed to the liver. Lavage may be called for in the severe type of eructation which attends dilatation.—Ed.

that is to say, they are dependent upon a virus which increases in quantity in the affected area, thus causing the characteristic spreading of the inflammation. The virus is present in the fluids of the inflamed area, and the disease can be communicated from one individual to another by inoculation of the inflammatory products; and in the case of cutaneous erysipelas, at least, there seems reason to believe that the poison may also be carried by the air. In all erysipelatous inflammations the virus diffuses itself by the lymph-spaces and lymphatic vessels of the affected part, showing little or no tendency to invade the blood-vessels, and to be disseminated by the blood-stream to distant parts. It is probable that there is more than one virus which may thus give rise to a spreading lymphatic inflammation; but in the vast majority of cases clinically described as erysipelas, which have been submitted to examination, a micro-organism of a definite form has been found, which is believed to be the actual virus. In 1869 Hueter suggested that the virus of erysipelas was probably a micro-organism, and thought that he had found it in the discharges of the inflamed part. In 1880 Lukomsky, Tillmanns, and others discovered the presence of micrococci in the lymph-spaces of the skin at the advancing edge of the rash in cutaneous erysipelas; but in 1882 the relation of these organisms to the disease was clearly demonstrated by Fehleisen. A small piece of the skin from the advancing edge of the rash was removed with proper precautions to avoid contamination, and planted upon some nutrient gelatine. From this a film soon spread over the gelatine, which on microscopic examination proved to be a pure cultivation of a micrococcus. The organism belongs to the genus streptococcus—that is to say, it shows a tendency to grow in chains or pairs. It does not liquefy the gelatine in its growth. This organism, after cultivation for several generations upon gelatine, gave rise to typical erysipelas when inoculated on the ear of a rabbit. Subsequently inoculations were made on the human subject with the intention of setting up erysipelas for the relief of lupus or incurable cancer. Seven cases were thus treated and genuine cutaneous erysipelas followed the inoculation in six; the seventh patient had recovered from an attack of erysipelas a few months before. Other observations seemed to show that one attack of erysipelas confers upon the patient a short period of immunity to the disease.

In all forms of cellulo-cutaneous erysipelas and in diffuse cellulitis a streptococcus exactly resembling that described by Fehleisen is found in the fluid filling the lymph-spaces of the affected part, whether it be purulent or serous. It cannot be distinguished from that found in cutaneous erysipelas by its reaction to aniline dyes, by its mode of growth, or microscopic appearances. To this micrococcus Rosenbach gave the name of streptococcus pyogenes. Cultivations of this organism cause acute suppuration when inoculated on animals; but it has lately been asserted that when inoculated superficially on the ear of a rabbit typical cutaneous erysipelas is set up. It has been stated that cultivations of the streptococcus erysipelatosus from the human subject injected into the subcutaneous tissue of the rabbit have given rise to deep-seated phlegmonous inflammation and suppuration. This is, however, denied by Fehleisen, who asserts that he has repeatedly injected erysipelas micrococci into the subcutaneous tissue and muscles of rabbits without causing inflammation or suppuration. The identity of the organisms must, therefore, be considered an open question at the present time. Clinically the simple cutaneous variety of erysipelas differs so widely from the subcutaneous forms that it is difficult to believe they are due to the same virus. In cutaneous erysipelas the streptococci are found in the lymph-spaces of the cutis at the advancing margin of the rash. Their presence excites the ordinary phenomena of inflammation—the blood-vessels are injected, and abundant migration of colourless corpuscles takes place. These seem to destroy the micro-organisms, which are not to be found in the more central parts of the rash. The persistence of the phenomena of inflammation in the parts in which no streptococci can be demonstrated must be supposed to be due to the damage done to the tissues by the chemical products formed during the growth of the organisms. The organisms never enter the blood-vessels locally, and though very probably some may find their way into the blood-stream by the lymphatics, there is no reason to believe that they multiply in the blood. The constitutional symptoms are therefore due to the entrance of the chemical products of the local process into the blood-stream, and not to any general infective process. In phlegmonous erysipelas and in cellulitis the streptococci can be easily demonstrated in the inflammatory exudation filling the lymph-spaces in the whole affected area, and not only at the advancing margin; but, as in the cutaneous form, the organisms have not been proved to infect the blood. Further evidence of the absence of blood infection is furnished by Fehleisen's experiment on the rabbit's ear. Having induced typical cutaneous erysipelas by the inoculation of a pure cultivation of the streptococcus, he amputated the ear with a Paquelin's cautery, with the effect of immediately relieving the elevation of temperature and all other constitutional symptoms. It is not proved, however, that the virus may not enter the circulation from the alimentary canal or the air-passages, and be carried by the blood, without actually infecting it, to some part which, from local injury or other cause, may form a suitable point for its development. On the assumption that the streptococcus is the actual virus, this seems the only possible explanation of many cases of erysipelas, especially of the cellulo-cutaneous or cutaneous variety, in which no evidence of direct inoculation by a wound or otherwise can be obtained.

The streptococcus grows readily at ordinary temperatures on gelatine, agar-agar, and potatoes, and probably on almost any damp organic matter. It has been said to have been found on the floor of an affected ward. This explains the well-known fact that hospital wards are apt to become infected, case after case breaking out until the ward is closed and disinfected. In military practice, erysipelas is very rare except in cases treated in civil hospitals. In this respect it differs from hospital gangrene and pyæmia, which can always be generated by crowding the wounded in buildings of any kind. It seems probable therefore that the virus is really specific, like that of scarlet fever or smallpox. That it can be carried by the air seems also to be proved, as the streptococcus has been detected on potato cultivations made from the air of infected wards. The cultivations thus obtained gave rise to erysipelas when inoculated on a rabbit. There is little doubt, however, that it is more commonly conveyed by the hands or clothes of the attendants. Erysipelas certainly does not show the same degree of infectiousness as most of the acute specific diseases.

The micro-organism is killed in 45 seconds by a 1 in 30 solution of carbolic acid, and in 15 seconds by a 1 in 1,000 solution of perchloride of mercury.

All the evidence above given tends therefore to show that erysipelas is a local disease, dependent on the invasion of the tissues by a specific micro-organism, and that the constitutional disturbance is secondary to the local. The opposite view has been held by many authorities, who have classed erysipelas with the acute specific fevers, regarding the rash as the local manifestation of a general condition. The arguments in favour of the latter are briefly as follows: (*a*) In many cases there is a distinct period of invasion in which the constitutional symptoms are present without the local; (*b*) there is frequently no evident point of inoculation; (*c*) the constitutional symptoms in cutaneous erysipelas are often much more severe than the local inflammation seems sufficient to account for.

Against these it is urged by those who support the local theory: (*a*) that even during the apparent period of invasion without local phenomena, a careful examination will detect some swelling of the lymphatic glands or other evidence of local mischief; (*b*) that the minutest abrasion merely being necessary for inoculation, it is very easily overlooked; and (*c*) that when we consider the intensely poisonous nature of the products of the growth of micro-organisms in albuminous fluids, the constitutional symptoms are not greater than might be expected. The results of the inoculations, and Fehleisen's experiment of amputation of the rabbit's ear above mentioned, and the fact that inoculation of the blood has never communicated the disease, nor have organisms been satisfactorily demonstrated in it, are further proofs of the local nature of the disease. Moreover the disease does not run a definite course like an acute specific fever. The fever continues as long as the rash is extending, and ceases as soon as that comes to an end. It must be remembered, however, that it is not proved that the blood may not serve as a carrier of the virus, though not as a medium for its growth, as in many other infective diseases—tubercle, for example. Granting therefore that erysipelas is an infective disease, and that the micro-organism above described is the actual virus, the predisposing causes may be divided into (1) *those favouring the growth and dissemination of the organism out of the body*; and (2) *those predisposing the patient to receive it.*

1. (*a*) *Accumulations of decaying animal or vegetable matter*, upon which the organism can develop, will predispose to the disease. Thus the presence of a dust-heap near a window of a ward, has been known to cause repeated outbreaks of erysipelas in the nearest bed. Dampness of the floors, from repeated washing, has also been said to predispose to erysipelas. Decomposing discharges from wounds, and want of cleanliness in dressings, are also important causes. (*b*) Certain meteorological conditions are said to predispose to erysipelas. East winds, low temperature, excessive moisture, cold and heat, have all been considered causes, but the evidence on these points is very unsatisfactory. It is certainly least common in the hottest and driest part of the year, and more common in spring and late autumn. (*c*) Bad ventilation leads to concentration of the virus and increases the chances of infection. (*d*) The virus can undoubtedly be carried by the medical and other attendants, but risk of this happening is greatly diminished by the proper use of antiseptics.

2. (*a*) A constitutional predisposition to erysipelas is occasionally met with, which is sometimes hereditary. The patient usually suffers from repeated attacks of the disease. One attack of erysipelas is therefore said to predispose the patient to another. (*b*) Exposure to the impure atmosphere of badly ventilated or overcrowded wards increases the liability to erysipelas. (*c*) Imperfect hygienic conditions generally, such as bad or insufficient food, impure water, &c., predispose the patient to the disease. (*d*) Diseases of the liver or kidneys make a patient especially liable to it. (*e*) The abuse of alcohol is one of the most important of all predisposing

causes. The great majority of the cases of fatal phlegmonous erysipelas occur in hard drinkers. (*f*) Age has no influence. (*g*) The disease is said to be more common in women, especially at the menstrual period. (*h*) The presence of a wound or abrasion to serve as the seat of inoculation is the only important local predisposing cause of erysipelas.

Erysipelas undoubtedly occurs in *epidemics*, and the type of the disease varies in different outbreaks. We know nothing of the causes which render the disease epidemic.

We shall now proceed to discuss in detail the several varieties of erysipelas summarised above.

I. Simple Cutaneous Erysipelas.—This is the most typical form of the disease.

Anatomical Characters.—The *post-mortem* appearances of erysipelas are by no means characteristic. The redness of the inflamed area of course fades after death, leaving a faint yellowish tint. The skin feels hard and inelastic, and the subcutaneous tissue contains an excess of serous fluid. In very acute cases there may be the usual signs of blood-change seen in all malignant fevers: early *post-mortem* staining, imperfect coagulation of the blood, subserous petechiæ, swollen and soft spleen, and cloudy swelling of the liver and kidneys. Hiller states that microscopic examination of the blood before death shows many of the white corpuscles to have undergone degenerative changes and become converted into masses of highly refracting granules. Busk has described plugs of such altered corpuscles in the small vessels of the lung, and Bastian has observed a similar condition in the vessels of the brain. Microscopic examination of the affected part of the skin shows large numbers of migrating leucocytes, lying in the spaces of the fibrous tissue, amongst the fat-cells, and in the lumen of the lymphatic vessels. They are especially abundant round the small vessels. The micro-organisms found in the lymph-spaces of the skin at the advancing margin of the rash have been already described.

Symptoms.—In simple erysipelas the constitutional symptoms often appear to precede the local. The invasion is marked by chilliness, seldom by an actual rigor; loss of appetite; general malaise; nausea, but seldom actual vomiting; headache; pain in the limbs; and the usual signs of pyrexia. The invasion is tolerably sudden. The temperature rapidly rises, to about 103° F., or higher. The rarer symptoms at this stage are epistaxis in adults, and convulsions in children. Usually within twenty-four hours of the invasion the characteristic cutaneous inflammation becomes evident. It may, however, commence simultaneously with the febrile disturbance, or be delayed even for two or three days. Frequently the lymphatic glands nearest to the part are swollen before the cutaneous eruption appears; afterwards they are invariably enlarged and tender. The local inflammation usually, if not always, starts from some wound, scratch, or abrasion. It commences indifferently in a fresh wound or a granulating sore. When no wound can be recognised as its starting-point, it usually starts from the junction of mucous membrane and skin, most commonly from the corner of the eye, causing a swelling across the bridge of the nose. It may also start from the angle of the mouth, the external auditory meatus, or the anus. It may commence in the nasal fossæ or pharynx, and extend outward to the skin of the face. Possibly in all cases it starts from some slight abrasion which is scarcely to be detected (Trousseau). The inflamed skin is bright red in colour, with sometimes a yellowish tinge; the redness advances in all directions, but usually most rapidly in that of the lymph-stream. The advancing margin is irregular, sharply defined, and very slightly raised. The cutis is œdematous, and pressure with the finger-nail leaves a deep and abiding mark. Where the subcutaneous areolar tissue is lax, as in the eyelids or scrotum, it also becomes greatly swollen. In the limbs the subcutaneous swelling is great only in severe cases. In many cases small vesicles rise, which may coalesce, forming blebs of considerable size. These ordinarily contain clear yellow serum, which, in bad cases, may be stained with blood-pigment. As these bullæ burst they dry up, forming scabs on the surface, but no ulceration takes place beneath these scabs. The inflammation has but little tendency to end in suppuration; when this does occur it is in those parts in which the œdema has been greatest, as the eyelids. There is heat, tension, and pain in the affected part, and a peculiar sensation of stiffness, which may even precede the appearance of the redness.

The febrile symptoms which usher in the attack remain unrelieved so long as the redness continues to spread. The pulse is at first quick and full, but it soon loses force, and in bad cases becomes extremely rapid and feeble. It is by the pulse, more than anything else, that the gravity of the case is marked. The temperature seldom rises above 106° F., though 107·5° F. has been recorded. The daily variations are not great, there being merely the usual slight morning fall and evening rise. Delirium is not uncommon at night, even in mild cases. In erysipelas of the head it may be a prominent symptom. It is usually due to the blood-condition, and not, as was formerly supposed, to extension of the inflammation to the membranes of the brain. This, however, does occur in rare cases, especially in erysipelas of the orbit, or in that following a compound fracture of the skull. The tongue is always foul, and usually dry; in bad cases becoming cracked and brown, with sordes on the lips and teeth. In erysipelas of the head the fauces are always red and congested, even when the inflammation has not actually extended to that part. The bowels are sometimes confined, but diarrhœa with offensive motions is liable to occur. There is nothing characteristic about the urine. As in other acute febrile diseases, it frequently contains a small quantity of albumen. In erysipelas of the head, when the disease reaches its height, the appearance is often hideous in the extreme, the features being completely obliterated by the swelling of the lax subcutaneous tissue, and the face further disfigured by the scabs formed by the dried blebs.

The duration of simple erysipelas is very uncertain. The cessation of the disease is marked by the inflammation ceasing to extend, and by a simultaneous fall of temperature, often very sudden. This may occur as early as the fifth day, or be delayed till the end of the second or middle of the third week. As the rash fades its margin loses its distinct outline, and the redness shades off insensibly. It is not uncommon to see the inflammation spreading at one part, fading at another. After the subsidence of the inflammation there is desquamation of the cuticle, and in erysipelas of the head often complete loss of hair, which is, however, never permanent. Even after a mild attack the patient's strength is much reduced, and he often remains weak and anæmic for a considerable time. Relapses are by no means uncommon. When death occurs from simple cutaneous erysipelas, it arises most frequently from exhaustion. It may also be due to the gravity of the blood-change. Occasionally the fatal termination is preceded by violent delirium ending in coma. Sometimes it is due to complications, as pleurisy or pneumonia, or in very rare cases meningitis. When sloughing of the skin or suppuration occurs, death may take place from septicæmia or pyæmia.

VARIETIES.—Some writers have divided simple erysipelas into *medical* and *surgical* —or *idiopathic* and *traumatic*, and have described these varieties as distinct diseases. They are, however, probably identical, for the following reasons: they closely resemble each other in mode of invasion, course, and pathological changes; infection from so-called idiopathic erysipelas will give rise to the traumatic form in patients suffering from an open wound; and during an outbreak of erysipelas in a surgical ward, patients without open wounds are occasionally attacked by the idiopathic form. Erysipelas has also been subdivided according to the part it attacks, as erysipelas faciei, capitis, scroti, &c.

Erysipelas occasionally affects the mucous membrane of the pharynx and upper part of the larynx. This form presents some peculiarities, and is spoken of as *erysipelatous pharyngitis* and *laryngitis*. The invasion and constitutional symptoms are similar to those of simple cutaneous erysipelas. There is a bright redness of the back of the pharynx and the fauces, always accompanied by considerable œdema of the soft palate and some swelling of the tonsil. The glands at the angle of the jaw are swollen and tender. The danger of this affection arises from extension to the glottis, causing œdema glottidis, with intense dyspnœa, expiration being more easy than inspiration, and both liable to obstruction by spasm. In such cases tracheotomy or laryngotomy may be required at any moment, to prevent death from asphyxia. In other cases the inflammation may extend forwards and appear on the face, either at the nostril or mouth, and afterwards extend as ordinary facial erysipelas.

Erysipelas occasionally attacks new-born infants, starting from the navel or genitals. This form has been spoken of as E. neonatorum. Serous membranes, especially the peritoneum, are said sometimes to be affected by erysipelas following wounds. In lying-in women the poison of erysipelas seems, in common with that of many other unhealthy inflammations, to be capable of causing puerperal fever.

Dermatologists have, according to their wont, invented a name for every possible variation. Thus when the inflammation spreads at one part while fading at another it has been called E. ambulans or erraticum; when spreading in a winding course, E. serpens; when causing small vesicles, E. vesiculare or miliare; when blebs form, E. bullosum; when there is much swelling, E. œdematosum, &c. Such names are useless, and might be multiplied *ad infinitum.*

DIAGNOSIS.—When erysipelas is fully developed it is scarcely possible to mistake the disease. During the stage of invasion, before the appearance of the rash, diagnosis is impossible. Simple diffuse inflammation around a wound or abscess is distinguished from erysipelas by the absence of the characteristic invasion, and of the sharply defined border. Simple erythema differs from erysipelas in the absence of fever, and in the eruption being composed of numerous isolated patches. Occasionally, in malignant smallpox, there may be much redness and swelling of the face before the appearance of the vesicles, but the symptoms of invasion are much more severe than those of erysipelas.

PROGNOSIS.—The prognosis depends chiefly upon the gravity of the general symptoms. The following are bad signs: high fever, violent delirium, excessive diarrhœa, early prostration, and very dry tongue with sordes. The extent of the inflammation is of less importance. Old age, disease of the kidneys or liver, and especially chronic alcoholism, add greatly to the gravity of the case. When erysipelas affects the pharynx there is always danger from œdema glottidis. In uncomplicated cases the death-rate is not high. Of

25 patients treated in the medical wards of University College Hospital for facial erysipelas from 1872 to 1876, only one died, and he was suffering from chronic Bright's disease.

TREATMENT.—1. *Constitutional.*—Erysipelas being a most exhausting and depressing disease, no antiphlogistic treatment is ever justifiable. Clear the bowels at the commencement of the attack, but avoid violent purgation. Only two drugs have any reputation in the treatment of erysipelas. The tincture of perchloride of iron, in large and repeated doses, has been strongly recommended by Dr. Reynolds and others, and is stated by some to act as a specific. To be of any use it must be given in doses of forty minims every four hours. Aconite, if administered as soon as the temperature begins to rise, is said to cut the attack short. It may be given in half-minim or minim doses of the tincture, at first every quarter of an hour for one or two hours, and afterwards hourly, till the skin becomes moist and the temperature falls, but its effects must be very carefully watched, to avoid dangerous depression. The *diet* must be as nourishing as possible—beef-tea, eggs and milk, &c. Solid food can never be taken during the advance of the disease. Stimulants are usually required, and the amount must be regulated by the pulse. Large quantities are often necessary.

2. *Local.*—Local treatment is very various. Warmth and avoidance of variations of temperature are essential. Cold is utterly inadmissible; it aggravates the inflammation, and tends to cause suppuration or even sloughing. Hot fomentations or hot baths may be employed when the part affected renders them admissible. In other cases dry warmth must be used; it is best obtained by covering the affected part with a thick layer of cotton-wool. Poultices should be avoided, as they needlessly irritate the skin, and are dirty and apt to get cold. With the application of warmth innumerable varieties of local applications have been recommended. These may be divided thus: (*a*) *Indifferent applications.* These are intended only to exclude the air, but they have the disadvantage of shutting in the secretion of the skin. The most common of these are collodion, oil, and a thick layer of flour or starch under cotton-wool. (*b*) *Sedative applications.* The most important remedy of this class is belladonna. It is best applied as a paint composed of equal parts of the extract and glycerine. It is especially useful when there is much inflammation of the lymphatic vessels and glands. (*c*) *Powerful astringents.* Valette, of Lyons, recommends a 30 per cent. solution of perchloride of iron; Higginbottom a solution of the 'brittle stick of nitrate of silver'—20 grains to one drachm of water. Before applying either of these, the skin must be carefully washed with soap and water to free it from grease. The perchloride of iron must be rubbed in with a glove. (*d*) *Antiseptic applications.* Marshall recommends creasote made into a paste with kaoline; Dewar, equal parts of sulphurous acid (B.P.) and glycerine. Tincture of iodine is a common application. Koch recommends an ointment composed of creolin 1 part, iodoform 4 parts, and lanolin 10 parts. Hueter practised the subcutaneous injection of a 1 in 30 solution of carbolic acid. He stated that this causes an immediate arrest of the inflammation for a small distance round the puncture; if, therefore, the treatment be adopted at so early a stage that the area of inflammation can be surrounded by four or five punctures, the disease may be checked. Beyond this there would be danger of carbolic-acid poisoning. Kraske and Riedel recommend scarification of the advancing margin with a special instrument, and the subsequent application of lint soaked in a 1 in 500 solution of corrosive sublimate. (*e*) *Drawing a limiting line* in front of the advancing rash. This has been done with solid nitrate of silver and with blistering fluid. It is utterly useless. Wölfler recommends the application of pressure immediately in front of the advancing line of redness by means of adhesive plaster. He believes this prevents the invasion of the lymph-spaces by the micrococci.

Erysipelas of the fauces is best treated by the local application of a strong solution of perchloride of iron. If there be œdema glottidis the swollen parts must be scarified, and if this fails to give relief, tracheotomy may be necessary.

II. Phlegmonous or Cellulo-cutaneous Erysipelas.—This was described by Dupuytren under the name of 'diffuse phlegmon.'

ANATOMICAL CHARACTERS.—Incisions made into the inflamed part in the early stages show the spaces of the areolar tissue distended with a semi-solid inflammatory exudation; a little later this is found to be a turbid and puriform fluid; later still the subcutaneous cellular tissue is represented by masses of shreddy sloughs soaked in pus. Unless exposed to the air by incisions or by sloughing of the skin, these sloughs are free from any odour of decomposition, and contain no gas. The streptococcus already described can invariably be demonstrated in the exudation fluids of the affected part. There is nothing characteristic in the *post-mortem* appearances of the internal organs.

SYMPTOMS.—The invasion is usually marked by chilliness or a rigor, elevation of temperature, nausea, headache, and general malaise. The local inflammation may commence in some wound or abrasion, but it may also arise spontaneously. From the beginning there is marked œdema of the subcutaneous tissue. The skin is reddened, but the margin of the redness is not sharply defined, and swelling and tenderness of the lymphatic glands are often absent. As the area of inflammation extends, the affected part becomes tense and brawny, and vesicles or large blebs form. The tension may become so great that firm pressure with the finger scarcely makes any impression. In a few days from the commencement of the disease, the greater part of a limb may be involved. If unrelieved by treatment, the tint of the redness becomes more dusky, and dark purple patches appear. At the same time the tension becomes less, and gives place to a soft, boggy feeling, indicating sloughing of the subcutaneous cellular tissue. Then livid patches appear, which break down into sloughs. As these sloughs separate, large shreddy masses of gangrenous cellular tissue can be drawn out, leaving the undermined skin connected with the deeper parts only by bands containing the larger vessels. Finally, the remaining skin being insufficiently nourished may become thin and melt away, leaving large tracts of the fascia or muscles beneath exposed to view. In this way, if proper treatment be not adopted in time, the greater part of a limb may be denuded of its cutaneous and subcutaneous covering. The extreme stage may be reached in a week or ten days, but a longer time usually elapses before all the sloughs have separated. In the earlier stages there is much burning and tensive pain, but this subsides as gangrene sets in. The constitutional symptoms are grave from the beginning. There is high fever, the thermometer often reaching 105° F. The tongue is dry and brown, and sordes accumulate on the lips and teeth; there is total loss of appetite; and diarrhœa is a frequent symptom. The pulse, at first full and bounding, soon loses force, becoming rapid and weak. Delirium, usually of the muttering type, is always present in severe cases. Death occurs from exhaustion, or from some complication, such as pneumonia, pleurisy, &c. During the separation of the sloughs septicæmia and pyæmia are of frequent occurrence. The disease most commonly attacks one of the limbs, but it is occasionally seen in the scrotum, and a peculiarly virulent form has been described as affecting the face. Phlegmonous erysipelas most commonly occurs in adult patients of broken constitution, suffering usually from the effects of the abuse of alcohol, or from some disease of the liver or kidneys.

Diagnosis.—From simple erysipelas the phlegmonous form is distinguished by the great swelling and brawny hardness, by the want of a sharply defined edge, and by the early tendency to sloughing; from spreading gangrene by its slower progress, and the absence of the rapid decomposition and development of gas in the tissues. Acute necrosis somewhat resembles it, but this disease is limited to young subjects, the swelling is less brawny, and when pus forms there is distinct fluctuation and not the boggy feeling of phlegmonous erysipelas.

Prognosis. — The prognosis is always grave, especially if there be any delay in adopting the proper treatment. Early failure of the heart's force, excessively dry tongue, diarrhœa and vomiting are bad signs. The gravity of the case increases directly with the area affected.

Treatment.—The patient must be supported by good beef-tea, milk and eggs, and stimulants are usually required to be freely given. No depletory measures are ever justifiable. Ammonia with bark is sometimes of service. *Locally* the treatment in very mild and doubtful cases must consist in the application of hot fomentations, and extract of belladonna made into a paint with an equal amount of glycerine. As soon as there are any signs of tension, free incisions must be made to relieve it. The strictest antiseptic precautions should be adopted in making these incisions, and some efficient antiseptic dressing applied afterwards. Hot boric acid fomentations frequently changed, or sheets of salicylic wool (10 per cent.), moistened with boiling water and applied like a poultice, will be found very useful.

III. Diffuse Cellulitis, or Cellular Erysipelas.—In this disease the inflammation is confined to the subcutaneous cellular tissue, or to the planes of areolar tissue amongst muscles or beneath fasciæ. The course of the inflammation is similar in many respects to that of phlegmonous erysipelas, the only important difference being that the skin remains unaffected, or is only implicated in the later stages, as a consequence of the sloughing of the subcutaneous tissues.

Anatomical Characters.—The *post-mortem* appearances are similar to those of phlegmonous erysipelas.

Symptoms.—The local signs of diffuse cellulitis, when occurring in the subcutaneous tissue or beneath the superficial fascia, are marked œdematous swelling, gradually becoming brawny, slight redness of the skin, and usually mottling from over-distension of the superficial veins. There is no sharp limit to the swelling. There is intense tensive or burning pain, increased by movement, and acute tenderness on pressure. The neighbouring lymphatic glands are in most cases swollen and tender. As the disease advances, the swelling becomes doughy, and possibly an indistinct sensation of fluctuation may be felt. The skin now becomes redder, and the gangrenous inflammation may even extend to it, unless prevented by treatment. An incision in the œdematous or brawny stage merely shows the areolar spaces distended with serum, sometimes clear, more often turbid. If the incision be delayed till the later stages, the affected cellular tissue is reduced to a mass of shreddy sloughs soaked in pus. Gas does not form amongst these sloughs till after air has been admitted from without. In mild cases the inflammation may localise itself, and lead to the formation of a large abscess. The constitutional symptoms are always grave. The temperature is high, 104° to 106° F. There are the usual symptoms of fever; the tongue is foul and speedily becomes dry; vomiting and diarrhœa are not uncommon; the pulse, at first quick and full, soon becomes feeble and rapid. There is almost always delirium. The disease usually runs a rapid course, two or three days sometimes being sufficient for it to reach its extreme stage.

Diffused cellulitis, as above described, is most frequently the result of a poisoned wound; it may then start from the wound or make its appearance at a distant part. It forms the most fatal variety of *post-mortem* wound; and, as is well known, in such cases the puncture may appear healthy, whilst the areolar tissue in the pectoral region may be the seat of most acute diffused inflammation. The bite of the less poisonous reptiles causes a similar diffuse inflammation. Diffuse cellulitis of the pelvis is a common cause of death after lithotomy, and is not uncommon in women after labour. Diffuse cellulitis beneath the pericranial aponeurosis is of frequent occurrence after scalp wounds. Occasionally the disease arises spontaneously, and it is then most common in the upper limb; but it has been seen in the areolar tissue of the neck and in many other regions. In pyæmia and septicæmia patches of diffuse cellulitis may appear in intermuscular spaces, or in the subcutaneous tissue.

Diagnosis.—The diagnosis of cellulitis is often difficult when the mischief is deep-seated. The œdema, pain, and tenderness, with the severe constitutional symptoms, are the chief guides; but even when these are well-marked, the extent of the inflammation and the necessity for active treatment are often difficult to determine.

Prognosis.—This depends much upon the cause, and upon the previous health of the patient. It is a very bad sign when the gravity of the general symptoms is out of proportion to the local mischief. In the pelvis cellulitis may be fatal from peritonitis; in the neck it is very fatal; it is much less dangerous in the limbs. When it occurs as a part of pyæmia or septicæmia the prognosis is of course very grave.

Treatment.—Early incisions into the inflamed cellular tissue, with antiseptic applications and abundant support, form the only reliable treatment in severe cases. In slight cases the application of extract of belladonna and glycerine (equal parts), with hot fomentations, may lead to resolution or limitation of the inflammation.

IV. Erysipelatous Lymphangitis.—Inflammation of the superficial lymphatic vessels is a common accompaniment of all varieties of erysipelas; but in some cases it forms by far the most prominent local morbid condition.

Symptoms.—This affection is characterised by red lines running in the course of the lymphatic vessels from some local sore or wound. The lines are at first tolerably sharply defined, and about a quarter of an inch in width, but after a short time they spread out and several may coalesce, forming a patch exactly resembling simple cutaneous erysipelas. There is slight œdema, some pain and stiffness, and acute tenderness on pressure. The lymphatic glands to which the vessels lead are swollen and tender. The constitutional symptoms are the same as in simple erysipelas.

Diagnosis.—This affection can only be mistaken for phlebitis; but the diagnosis is easily made by observing the course of the lines, and by the absence of the knotted cord formed by the coagulation of the blood in an inflamed vein.

Treatment.—The treatment is the same as in simple erysipelas. The extract of belladonna and glycerine is especially useful in this form of erysipelatous inflammation.

V. Erysipelatous Phlebitis.—Inflammation of the superficial veins, rapidly spreading in the course of the circulation, accompanied by thrombosis, redness of the skin, and acute tenderness, has been supposed by some authors to be erysipelatous in character. The only evidence in favour of this view is that the invasion and the constitutional symptoms resemble those of erysipelas, and that the affection is not uncommon during epidemics of erysipelas. *See* Veins, Diseases of.

Various other diseases have been classed as erysipelatous; the chief of these are whitlow, some forms of puerperal fever, and diffuse peritonitis after operations affecting the peritoneum; all these will be described elsewhere. Diffuse inflammation not infrequently occurs after punctures made to allow of the escape of the fluid in the dropsy of cardiac or of renal disease. That punctures made into feebly nourished tissues bathed in decomposable serous fluid should set up diffuse inflammation is not surprising, but evidence is wanting to prove that such inflammation is necessarily connected with erysipelas.

Marcus Beck.

ERYTHEMA (ἐρυθρός, red).—Synon.: Rose-rash; Fr. *Erythème*; Ger. *Hautröthe.*

Definition.—A non-infective superficial inflammation of the skin, the essential characteristic of which is redness, that disappears on pressure by the finger, reappearing when the pressure is removed. The hue may vary from a bright rose to a dark blue red; it may or may not be accompanied by swelling; the part may be hotter than natural; and the appearance may present itself as spots, circumscribed or diffuse, or as wheals. It is sometimes attended by a sensation of slight burning or itching, but generally gives rise to no subjective symptoms. After it has disappeared the skin is either normal, or remains slightly pigmented, or desquamates. Generally there is an increase of temperature, with slight feverish symptoms. Erythema may be either *symptomatic* or *idiopathic.*

Symptomatic Erythema.—Ætiology and Varieties.—Erythema occurs in rare instances after the administration of drugs. Cases are recorded after the ingestion of arsenic, belladonna, chloral hydrate, copaiba, cubebs, digitalis, iodides, opium, quinine, salicylic acid, stramonium, strychnine, phenazone, and turpentine. The rash usually appears immediately after the absorption of the medicine into the circulation; after arsenic it appears at a later period. *See* Drug Eruptions.

Exposure to heat or cold, and contact with various acrid or poisonous substances, are also common causes of erythema. Friction and (in the absence of cleanliness) the secretions of the skin itself, may give rise to it, as when *erythema intertrigo* is produced between the scrotum and thighs by the irritation of profuse sweat and sebaceous secretions. The blush of shame or of anger is an erythema produced by the immediate action of the vaso-motor nervous system.

Variola, cholera, enteric fever, typhus, septicæmia, rheumatic fever, and various other less distinctly defined febrile conditions, are frequently accompanied during various stages of their course by a more or less generally diffused and mostly ephemeral form of erythema.

The *roseola infantilis* of authors is an erythema that accompanies intestinal disturbance, teething, and various other disordered conditions of the system in children. Its appearance may exactly simulate that of measles or scarlatina; but it differs from these in disappearing in less than twenty-four hours, and in leaving no desquamation behind it.

The erythema that accompanies smallpox—*roseola variolosa*—appears generally on the second day of the disease, either as a diffuse redness of the whole integument, or as bright red spots, which are seen first on the face and then on other parts of the body. It lasts from twelve to thirty-six hours, and disappears when the smallpox eruption begins to show itself. A special limited form of erythema has been observed on the second and third days of smallpox, extending from the hypogastrium down the front of the upper two-thirds of the thighs; the affected surface, when the legs are closed, having the form of a triangle the base of which is across the lower part of the abdomen. This surface remains almost or entirely free from the variolous pustules, and many of the cases in which it is present end fatally.

From the third to the eighteenth day after vaccination, small or large erythematous patches—*roseola vaccina*—are sometimes seen, generally on the arms, but also on other parts of the body. They usually disappear within twenty-four hours, and leave neither desquamation nor pigmentation.

The forms of erythema mentioned above cannot be considered as being in themselves specific varieties of disease, and pathologically consist in a temporary injection of the capillary blood-vessels of the skin. They are to be distinguished from the erythemata that run a distinct course, terminating in pigmentation and desquamation, and in which the capillary injection is accompanied by exudation.

Idiopathic Erythema.—I. *Erythema multiforme.*—This form of idiopathic erythema is most commonly seen in spring and autumn, and is distinguished by its localisation. It begins on the backs of the hands and feet, and frequently is found in these situations only. In some cases it extends upwards to the shoulders and hips, and in very rare cases is also found on the trunk.

The appearance consists in flattened papules, from the size of a pea to that of a bean, of a dark blue or brown-red colour. They are surrounded on their first appearance by a red zone, which soon disappears, and the border of the papule then stands out in fuller relief. The mildest form of this disease consists in papules which disappear after a few days—*erythema papulatum* vel *tuberculatum.* Instead of thus disappearing it may spread outwards from the edge, and flatten and become pale in the centre, thus forming a red ring, the condition being known as *erythema annulare.* While the first circle persists, a second ring may form around it, and the circles may be constituted by small papules, forming the condition recognised as *erythema iris* vel *mamellatum.* Another stage may be reached by the enlarging circles meeting, and so forming segments of a circle, constituting the form known as *erythema gyratum* vel *marginatum.* In consequence of increased exudation erythema papulatum may assume the aspect of a wheal, forming *erythema urticatum* or *lichen urticatus.* This condition is attended with considerable itching; and, in consequence of scratching, the centre of the papular wheal is often covered by a minute bloody crust. The exudation may be sufficient to give the eruption the aspect of vesicles or bullæ, the so-called *erythema vesiculosum* and *erythema bullosum.* Concentric circles of vesicles produce the appearance called *herpes iris.*

At any of these stages the eruption may disappear. The sequelæ are slight pigmentation and desquamation.

The disease, whose different stages have received the several names above indicated, has been designated, on account of the various forms under which it is seen, *erythema exsudativum multiforme.* It is accompanied by a slight feeling of burning, or by very slight itching. In the majority of cases constitutional symptoms are either absent, or are so insignificant as not to excite attention. There are, however, cases in which the symptoms are as marked as those which precede and accompany an eruptive fever. The prodromal symptoms are usually pain in the back, head, limbs, and joints, with gastric disturbance, and sometimes a congested condition of the throat and fauces. In severe cases the prodromal period has been observed during four to six days; and amongst other symptoms sneezing, bleeding at the nose, laryngitis, bronchitis, intense sweating, mental disturbance, and fever have been observed. All these symptoms may become aggravated during the period of eruption. In well-marked cases the disease may last from a fortnight to a month, but in exceptional circumstances the symptoms may be prolonged by fresh outbreaks of eruption. Simultaneously with the eruption on the skin, red spots may appear on the mouth and pharynx, from which the epithelium quickly disappears, leaving the parts raw and painful. Cases are recorded in which symptoms of severe intestinal disturbance, shivering, high fever, intense inflammation and ulceration of the mucous membrane of the throat, severe mental depression, and a painful condition of the joints, have been present.

In some cases the erythema is punctiform, and so much resembles the appearance of scarlatina that authors have described an *erythema scarlatiniforme.* It is distinguished from scarlatina by the absence or very slight degree of fever. The fauces, although red, are not swollen. There is no characteristic appearance on the tongue; and the pulse is little affected. There are no sequelæ.

Hebra relates that in a woman who died whilst an eruption of *erythema gyratum* was on the skin, similar red rings were found in the small intestine. It is most common in adolescence, and is more frequent in males than in females.

II. *Erythema nodosum.*—This name is given to a disease characterised by the appearance, chiefly on the surface of the lower extremities, of pale red hemispherical or oval swellings. These vary in size from that of a pea to that of a hen's egg, and are painful on pressure. Fever is sometimes present.

The swellings are at first pale red with a yellowish tinge, later dark red, and finally livid; after they disappear they leave behind them a yellow pigmentation similar to that which follows a contusion. The number of swellings may vary from a very few on the lower extremities to successive crops on different parts of the limbs and trunk. In the latter case the feverish symptoms are well-marked. The course of the disease is completed in from two to four weeks. The swellings never suppurate, never itch, are always painful, and the redness never spreads to the adjoining skin. This variety can occur in combination with the previously described forms of *erythema multiforme.*

Erythema nodosum is found to be so frequently associated with definite rheumatic symptoms, such as arthritis, sour sweats, sore-throat, endocarditis, and even myocarditis, that it may be considered very probable that the affection is allied with the rheumatic diathesis.

A case has been reported in which phlebitis leading to embolism has complicated the disease.

Ætiology.—The cause of erythema nodosum is not definitely known, although, as we have remarked, it is frequently associated with rheumatism. Some authors favour the view that it may be considered as a typical angioneurosis, whilst others believe that it is always an infective constitutional disease. It may occur at every age, but generally from eighteen to thirty, and most frequently in women. It occurs at all seasons, and debility predisposes to attacks.

Anatomical Characters.—The microscopical appearances are those of an inflammatory hyperæmia. Leucocytes are found around the blood-vessels, and there are extravasations of red corpuscles. There is also an effusion of serum between the cells of the epidermis.

Prognosis.—The prognosis of the special forms of erythema—*multiforme* and *nodosum*—is usually favourable, but cases are reported in which death has been caused by visceral complications. It is assumed that in these exceptional cases both the skin-eruption and the visceral lesions are produced by some infective poison. Those varieties seen in the course of other diseases do not as a rule modify the prognosis of the particular disease which each accompanies.

Treatment.—The treatment of erythema consists in palliating the attendant symptoms. Dusting with flour, or the application of spirit-lotion, should be employed when productive of a sense of comfort to the patient. In *erythema nodosum* warm applications of infusion of poppies or chamomile are soothing; while aperients and, when fever is present, gentle diaphoretics may be given internally. In many such cases tonics, especially quinine, are required.

George Thin.

ERYTHRASMA (ἐρυθρός, red).—This is a chronic, very slowly developing, contagious, epiphytic disease of the skin, characterised by a very slight erythematous inflammation, which usually occupies the cruro-scrotal or axillary regions, but is capable of wider generalisation; produced by the presence in the corneous layer of a remarkably minute fungus—the *microsporon minutissimum* (Burckhardt and Von Bärensprung).

Description.—Erythrasma is little known, and generally confounded with eczema marginatum. Fairly common in men, although it occasions little discomfort, it is less frequent in women, in whom it may be found about the axillary or perigenital regions.

The patches are rounded, not marginate or sensibly raised, from ¾ inch to 1½ inches or upwards in diameter, uniformly roughened, and coloured yellowish-red or brownish. The pruritus and inflammation are very slight.

There are abundant delicate mycelia and conidia present, forming a rich network round the cells. The fungus requires staining and high powers for its demonstration. It is said to occur normally on parts of the skin, but erythrasma has been inoculated by Köbner.

Treatment.—All parasiticide agents, such as iodine, resorcin, salicylic acid, and chrysarobin, capable of causing exfoliation, succeed in curing erythrasma. Relapses are apt to occur unless treatment is long-continued.

T. Colcott Fox.

ESCHAROTICS (ἐσχάρα, a slough).—Synon.: Fr. *Escharotiques*; Ger. *Aetzmittel.*

Definition.—Escharotics are substances that completely destroy the tissues to which they are applied, and produce a slough. They are distinguished from other caustics simply by the greater intensity of their action.

Enumeration.—The chief escharotics are: Red-hot metal, Sulphuric Acid, Nitric Acid, Caustic Potash, Chloride of Antimony, Chloride of Zinc, Acid Nitrate of Mercury, Bromine, Chromic Acid, and Lime. Weaker caustics are—Nitrate of Silver, Sulphate of Copper, Sulphate of Zinc, Iodine, Carbolic Acid, Arsenious Acid, Sulphide of Arsenic, and Dried Alum.

Action.—Escharotics combine with the tissues and destroy them. Around the part thus killed inflammation is set up, and the part is separated as a slough. Besides their local action, these agents act reflexly on other parts of the body through the nerves of the region to which they are applied.

Uses.—Escharotics are employed, first, to destroy the virus in, and the tissues around, a poisoned wound, and thus prevent the absorption of the poison—for example, in bites by snakes or rabid animals, or in cases of inoculation with syphilis, or with animal-poison in dissection or *post-mortem* wounds. Secondly, they are used to destroy unhealthy tissue, such as exuberant granulations, and to remove excrescences and morbid growths, as warts, condylomata, nævi, polypi, hæmorrhoids, and cancer. Thirdly, they are used to open abscesses, especially those of the liver. For this purpose caustic potash is usually employed. Lastly, by means of escharotics it is usual to establish issues, and thus react beneficially on distant organs.

T. Lauder Brunton.

ESSENTIAL PARALYSIS. — A synonym for infantile paralysis. *See* Paralysis, Infantile.

ESTCOURT, in Natal.—*See* Africa, South.

ETHER, Uses of.—*See* Anæsthetics.

ETIOLOGY.—*See* Disease, Causes of.

EUSTACHIAN TUBE, Diseases of. *See* Ear, Diseases of.

EUTHANASIA (εὖ, well; θάνατος, death).

Definition.—Mental and physical distress too often attends the approach of death; and by the term 'euthanasia' we express the measures by which we alleviate or seek to remove this distress.

Importance of Euthanasia.—To procure euthanasia is of great moment to the patient, to the patient's friends, and to the practitioner.

It is the duty, and should be the constant aim, of every thoughtful practitioner to acquire the art of successfully smoothing the death-bed of his patient. He will thereby be enabled, when this is necessary, to relieve him of much of the attendant suffering, and to prevent many troubles individually of smaller moment, but collectively the source of much discomfort or distress. The friends' anxiety will be lightened by the relief afforded to the patient. Their own efforts in this direction are frequently unsuccessful; indeed may sometimes be prejudicial. The comfort of the dying is very often interfered with, and actual suffering induced, by the interference of well-meaning but inexperienced friends or relatives. Indeed they will sometimes question the action of the practitioner respecting the employment of a measure of which he may wish to avail himself, or they will administer food and stimulants to the patient in quantities which may be excessive or deficient or given at improper intervals. Death may thus be very often accelerated, and not without discomfort. To the practitioner himself the subject of euthanasia is one of great importance. He is involved in a position of grave responsibility, demanding the display of much tact and judgment, and one by which his professional character will certainly, in part, be estimated. Much of his success will depend on his natural possession of these qualities, and to lay down any strict or rigid rules for his guidance is obviously impossible.

The Morbid States calling for Euthanasia.—1. *Mental Condition.*—The question of dealing with the mental distress of the dying is one which only secondarily concerns the practitioner, and will therefore be noticed but briefly here. The most important point to be decided is: Should the practitioner be the medium of communicating to his patient the hopelessness of his case? Whenever possible, this painful duty should be relegated to the friends of the patient, who are always to be informed of the approach of death, in order that due attention may be paid to the affairs of the sick person, both spiritual and worldly. The practitioner should not hastily take on himself to tell him of the inevitable result of his illness. The patient may or may not desire to know the truth, and when it is communicated to him it is certain to affect his peace of mind in the one or in the other direction. Some welcome the announcement; whilst others are filled with dread. But it is a fact that the majority of persons seriously ill feel less on such matters than they would have felt in health: they 'mate and master,' as it were, 'the fear of death.' With many patients, not to know the truth respecting the danger which they are in, is itself a form of unhappiness which militates against the establishment of euthanasia. The practitioner should therefore most carefully study the individual case and the character of his patient. On the one hand he will exercise the greatest care not to falsely conceal their situation from the dying; on the other hand, he must keep in mind that a fatal termination is not always *certain*, and that in many cases the last chance of an over-sensitive patient may be destroyed by the prospect of problematical dangers (*see* Disease, Prognosis of). Good sense, kind feeling, tact, and experience, will prove of the greatest value in discharging this delicate duty as it comes before us in a general practice. *See* Death, Modes of.

2. *Bodily Conditions.*—The physical states which specially call for euthanasia are—pain; dyspnœa, cardiac distress, exhausting cough; laryngeal distress; difficult expectoration; restlessness and sleeplessness; thirst; hiccough; abdominal distension; dropsy; bedsores; and exhausting discharges. These, and a few of the general and therapeutic measures at our command which ought ever to be present to the mind of the practitioner for abolishing or mitigating sufferings incident to the dying state, will now be briefly touched upon.

The removal of *pain* is essential for the promotion of euthanasia, and no other remedy is so successful for this purpose as opium or morphine cautiously administered. It is an adjunct of the greatest value to other measures, and, moreover, successfully combats the exhaustion and sinking sensations which, in certain cases, are a source of indescribable distress. Its anodyne effect is enhanced by its cardiac action. Its administration, however, often leads us into much fresh difficulty, by causing a dry tongue and distressing thirst; by arresting the excretions; in other instances by increasing the reluctance to take sustenance; or the presence of kidney-disease may prove a serious contra-indication to its employment.

The question as to the patient remaining out of bed pillowed up in a suitable chair will sometimes arise when *dyspnœa* and *flatulence* are urgent; and will demand much judgment and care. By rendering moist the air of the bedroom with the vapour of hot water in a bronchitis-kettle placed upon a fire (not over gas or spirit-lamp contrivances, which only tend to vitiate the atmosphere of the sick-chamber), we can often insure the relief of pulmonary distress. Uræmic dyspnœa will call for the administration of nitroglycerine, nitrite of amyl, or sulphuric ether.

Painful *cardiac* palpitation, and its attendant distress, often derive relief from the administration of antispasmodics along with iodide of potassium, a belladonna plaster at the same time being applied over the præcordia. Digitalis, strophanthus, strychnine, or some of the other well-known excellent cardiac tonics, may also be resorted to with success.

One of the most distressing symptoms in the dying is the exhausting *cough* of phthisis, which greatly exhausts the patient. It may be combated by judicious nursing; by an acid linctus, with or without the addition of a little morphine; by a combination of respiratory sedatives; by the frequent administration of small quantities of alcoholic stimulants; or by hot or cold liquid nourishment. The *laryngeal distress* which frequently attends the final stage of phthisis will best be relieved by morphine insufflations, cocaine sprays, or recourse may be had to rectal alimentation. The loud, noisy, gurgling râles met with in the last phases of bronchitis and other conditions will call for change of posture and stimulants, although they are more distressing to the friends than a source of danger to the patient (*see* Stertor). When the attempts at *expectoration* are difficult, measures must be employed which possess the power of diminishing the viscidity of the expectoration, or of stimulating the respiratory centre and the respiratory movements. *See* Expectorants.

The *restlessness* and tossing of the limbs, irregular sighing, with coincident *sleeplessness*, which so often attend the last days of fatal illnesses, may sometimes be relieved by attention to the weight of the bedclothes, which can be conveniently reduced by employing a suitable cradle. The arrangement of the pillows and attention to the posture of the dying patient constantly tax the ingenuity and resource of the attendants. The temperature and ventilation of the sick-room are also of great importance in this respect, closeness and over-heating being zealously prevented, as well as crowding of the sick-chamber with anxious friends. The feet and legs ought to be frequently examined, and if chilled they should be warmed by a carefully applied foot-warmer. The unpleasant effects of cold sweats will also call for attention. The catheter will remove another often overlooked cause of inquietude—a distended bladder. By these and similar measures we may be able to counteract the cause or causes of insomnia, and thus secure for our patient a few precious hours of sleep.

Thirst is often a most distressing symptom. It may best be relieved with ice, or with teaspoonfuls of iced water or acidulated, unsweetened, cold black tea or coffee. But in this connexion let it be understood that we must be careful to avoid the popular mistake of forcing down liquids in cases where life is evidently fast ebbing away. Such a practice necessarily embarrasses respiration, and we have likewise to remember that at this time the act of deglutition very often is in abeyance. Death is occasionally accelerated by injudicious attempts to raise the patient, open his mouth, and administer food.

In the management of the dying we have always to contend with an enfeebled digestion. The *diet* in such cases should be one easy of assimilation. It not infrequently happens that the food given may be excessive or deficient in quantity, or that it is administered at irregular intervals, thereby causing much distress to the patient. Success in this direction depends solely on the tact of the nurse. Whilst in acute disease nothing conduces more to success than definite instructions as to the amount and kind of the food to be given, and the hours for its administration, it is impossible and inadvisable to observe these rigid rules in the feeding of the dying.

In conjunction with nourishment we can often remove much of the suffering by the judicious selection and administration of *alcoholic stimulants*. If the patient tires of one form of stimulant, another should be tried, provided we are careful to use only such as are easily digested and assimilated, and given in divided quantities. A combination of beef-tea, liquor strychninæ hydrochloratis, and brandy is often very acceptable, especially in bad cardiac cases. Another stimulant of extreme service is ether, which particularly alleviates painful attacks of spasmodic breathing.

A sinapism to the epigastrium in conjunction with the internal use of a little ether and brandy, will frequently relieve that sometimes distressing symptom—hiccough.

Distressing *abdominal distension* must be relieved by the employment of turpentine stupes and by enemata containing some antispasmodic. *See* ENEMA.

The treatment of dropsy, abdominal distension, bed-sores, and exhausting discharges is dealt with in other parts of this work.

In addition to the conditions which call for euthanasia, it is clear that the severe dietetic restrictions which may have been enforced in a case of Bright's disease, diabetes, &c., ought to be reconsidered and removed when it becomes apparent that the patient's condition is absolutely hopeless. The wishes and suggestions of the patient may generally be acquiesced in, and they will prove a useful guide to the practitioner as to the line of action to pursue. It is often the wisest course to humour cravings. Seeming extravagances as to diet, if persistently asked for, had better be granted, especially when kind and gentle persuasion has failed to get the patient to waive his desire for them.

In addition to the means already mentioned, it need hardly be said that we still have all those measures which may be summed up in the expression 'perfect nursing,' which implies carrying out many details as well as exercising sympathy and tact—a nurse not overdrilled. A mere automaton thinks too much of her 'uniform' and of her 'duty.' JOHN HAROLD.

EVACUANTS (*evacuo*, I empty).—SYNON.: Fr. *Évacuants*; Ger. *Ausleerende Mittel.*

DEFINITION.—Medicines used to produce some evacuation from the body.

ENUMERATION.—The chief evacuants are: Sternutatories, Expectorants, Sialagogues, Emetics, Cholagogues, Purgatives, Diaphoretics, and Diuretics. *See* the several articles upon these subjects.

EVIAN-LES-BAINS, in Savoy, France.—Alkaline waters. *See* MINERAL WATERS.

EXACERBATION (*exacerbo*, I aggravate).—Increase in the severity of the symptoms of a disease. *See* DISEASE, Duration of.

EXANTHEMA; EXANTHEMATA (ἐξ, out; and ἀνθέω, I blossom). SYNON.: Fr. *Exanthème*; Ger. *Ausschlag.*

DEFINITION.—A rash or eruption on the skin attending a specific fever. The specific fevers attended by rash. This term, once denoting any cutaneous eruption, is now restricted to the eruptive fevers called the *exanthemata.* The febrile rashes or exanthems of local or individual origin — urticaria, erythema, and roseola—are not included with the true exanthemata, which are acute specific infectious diseases, namely, Typhus, Variola, Varicella, Morbilli, Rubella, Dengue, Scarlet Fever, Typhoid or Enteric Fever, and perhaps Erysipelas. As the leading features of these diseases will be discussed under their several heads, it is only necessary further to notice certain less defined and regular eruptions associated with fever.

All the exanthemata are attended with fever and enlargement of the lymphatic glands. Convulsions in children may occur with the first fever; in some of the diseases before the rash appears.

Typhus.—The mulberry rash appears suddenly on the fourth and fifth days of illness as a dull red mottling of irregular, persistent, non-elevated spots; the fever is high at the commencement, and continues to be so after the rash is fully developed.

Typhoid.—In typhoid or enteric fever the small, raised rose-spots do not appear till the second week of fever; sparsely scattered on the trunk, they fade on pressure, disappearing in three or four days, while new spots arise.

Smallpox.—Marked fever of sudden ingress occurs two days before the raised eruption. Sometimes a rose-rash first appears, but the severe symptoms begin a full day before this, and not more than two days before the characteristic spots. The cervical glands are enlarged.

Varicella.—The eruption begins on the first day of illness, with slight fever, increasing as fresh spots appear. The fever may be high and come on suddenly, but enlarged cervical glands and spots somewhere are always to be found at the same time.

Measles.—Three days of fever and catarrh, with palpable enlargement of the cervical glands, precede the rash; there is then sudden increase of fever, subsiding while the rash is at its height.

Rubella; Rubeola sine catarrho.—The rash appears within a few hours of the first feeling of illness, which is slight and soon over. The rash is at first spotted rather than finely diffused. By the time it is fully out the fever has subsided, but the enlarged cervical glands which marked the ingress always remain to indicate a specific disease. Fine desquamation rarely follows, and there is no albuminuria. Rubella spreads by direct infection, the incubation being from two to three weeks. This long period of incubation causes the source of infection to be often overlooked, and even the possibility of it to be denied. When carried to a family or school either an unnecessary alarm of measles is raised; or contagion is denied, and the next sufferers are said to have a rose-rash from heat, or from irritation of the stomach.

Dengue.—Widely spread in Africa, the warmer parts of America, and both the Indies, dengue may possibly be limited to hot climates; its presence with us is as yet undetermined. The rash is at first discrete, like that of measles, but follows soon after infection; and the disease in its general course is allied to influenza.

Scarlet Fever.—The finely diffused redness is found on the skin and in the mouth and throat often within a few hours of the sudden ingress of fever. The fever increases with the development of the rash, both persisting for several days. Often the throat is first complained of; the glands at the angle of the jaw are full and tender; the tongue presents prominent red papillæ projecting through the white fur. The skin is not swollen as in erysipelas, nor the redness so circumscribed; the throat also is redder; the cervical glands are enlarged in both. Surgical scarlatina is often declared three or four days after operations; the rash of septicæmia at a later period.

Epidemic Roseola.—This is a name for rötheln; also for a rash having such relation to scarlet fever as rubella to measles, but with slender claim to autonomy. Mild cases of scarlet fever often begin with a finely diffused redness shortly after some feeling of faintness or giddiness, and an incubation of from three days to a week; sometimes albuminuria occurs as an early symptom. The finely diffused rash, enlarged cervical glands, and slight sore-throat, even with very little elevation of temperature, raise the suspicion of scarlet fever; should albuminuria follow, or any shreddy desquamation of the hands and feet, no uncertainty remains. Scarlet fever so modified often spreads and gives rise to the severer forms of the disease, when it has been called only rose-rash or roseola; the use of these terms without a distinctive qualification always leaves a doubt as to the completeness and safety of the diagnosis.

Erythema.—Erythema comes nearest to these cases in appearance—so near as often to be spoken of as recurrent scarlet fever or erysipelas, but there is no enlargement of the cervical glands in erythema, and so little fever that the temperature of the reddened skin is barely elevated above the normal. Since Fuller's *Exanthematologia* this kind of flush passes under different names of roseola, according to the variations in shape of the red patches, or the seasons of the year at which they occur.

Erythema nodosum.—This disease is often preceded by slight fever for a day or two, which may reach 102° F., but subsides as the red swellings appear. Locally there is little or no elevation of temperature, even when the tender part feels hot.

Exanthematous Roseola.—This affection, occurring in the course of other specific diseases, is distinguished from the roseola which depends on nerve-irritation, such as that from acrid ingesta, by the presence either of high fever, or of glandular enlargement, or of both, as when it precedes the true variolous eruption. During enteric fever this form of roseola may occur quite independently of the special lenticular rose-spots.

An eruption of this kind is not infrequent in the early stages of diphtheria, sometimes as a diffused rash limited to certain parts of the chest and body, or as discrete spots on the limbs and back of the hands and feet. Influenza, and some forms of catarrh, winter 'colds,' or summer diarrhœa as noticed by Bateman, may present various kinds of roseola on the back, shoulders, and chest; the cervical glands are perceptibly enlarged, though there may be little fever. In these cases it is not the roseola, but the specific disease on which it depends, that might, without precautions, be communicated to others.

Syphilitic Roseola.—A special roseola marks the secondary stage of syphilis; in appearance it resembles the rash of measles. So does the *roseola ab ingestis* when produced by cubebs, but this has neither fever nor glandular enlargement.

The absence of fever from the roseola after vaccination refers this form of eruption, like that occurring from dentition, to the class of rashes from nerve-irritation. *Vaccinia* is itself an exanthem in the wider definition of the term, reproduced after a definite period of incubation by inoculating a special contagium. Wanting this character, the different forms of herpes are excluded, unless resulting from a general febrile disturbance; though inoculable, ecthyma and impetigo are local affections not belonging to the exanthemata.

William Squire.

EXCITANTS (*excito*, I excite).—It seems hardly necessary to give any special consideration to this therapeutical class, as all that may be said on the subject ranges itself with greater propriety under the heading Stimulants. Stimulation is, in fact, a degree of excitement; and it is only when its effects are more vigorously pushed, that we obtain that inebriation or exhilaration which is so commonly observed to follow the use of alcohol, ether, and the anæsthetic vapours. *See* Stimulants.

Robert Farquharson.

EXCITING CAUSES.—*See* Disease, Causes of.

EXCITO-MOTOR DISORDERS.—*See* Reflex Disorders.

EXCORIATION (*ex*, from; and *corium*, the skin).—The superficial destruction of a portion of the skin or mucous membrane.

EXERCISE.—Definition.—In its widest and most correct signification, exercise is the setting in motion any active body; and when the term is used in a physiological connection, it may refer to the functional activity of any of the organs, whether muscular, nervous, nutritive, secretory, or reproductive. In this very comprehensive sense, the subject of exercise includes a large portion both of hygiene and of therapeutics. The popular signification of exercise is, however, much more limited than the preceding, having reference only to the muscles directly, and to the parts called into play through the same—especially the circulatory and respiratory systems.

Whether in its wider or in its narrower sense, exercise has several important relations to Medicine. 1. It is essential to the preservation of health (*see* Personal Health). 2. It has to be regarded as frequently associated with the causation of disease (*see* Disease, Causes of). 3. Exercise is a most rational and successful means of treatment in certain disorders and diseases (*see* Movement, Therapeutical Uses of). 4. Exercise is often abused; and excessive indulgence in some forms of it gives rise to serious consequences. The present article will be devoted to the consideration of exercise in the last-named aspect only; and the subject will be discussed according to the more limited and popular definition of the term.

Abuse of Exercise.—From the moment an infant is born until the end of life, exercise, duly apportioned to rest, is the normal state of existence; and whilst continued overstrain of any portion of the human machine is the forerunner of disease, so, on the other hand, is equally, if not more so, that want of exercise which induces wasting and degeneration.

Principles.—The late Dr. Parkes, in his *Practical Hygiene*, has given a very complete statement of the results of the investigations of himself and others on the changes effected by the stimulus of muscular exercise on the various organs and tissues of the body, from which he has drawn the following conclusions:—

'The main effect of exercise is to increase the oxidation of carbon, perhaps also of hydrogen. It also eliminates water from the body, and this action continues—as seen from Pettenkofer and Voit's experiments—for some time; after exercise the body is therefore poorer in water, especially of the blood; it increases the rapidity of circulation everywhere, as well as the pressure on the vessels, and therefore it causes in all organs a more rapid outflow of plasma and a more active absorption—in other words, a quicker renewal.

'In this way, also, it removes the product of their action which accumulates in organs; and restores the power of action to the various parts of the body. It increases the outflow of warmth from the body by increasing perspiration. It therefore strengthens all parts. It must be combined with increased supply both of nitrogen and carbon (the latter possibly in the form of fat), otherwise the absorption of oxygen, the molecular changes in the nitrogenous tissues, and the elimination of carbon, will be checked. There must also be an increased supply of salts, certainly of chloride of sodium, probably of potassium phosphate and chloride. There must be proper intervals of rest, or the store of oxygen, and of the material in the muscles which is to be metamorphosed during contraction, cannot take place. The integrity and perfect freedom of action both of the heart and lungs is essential, otherwise neither absorption of oxygen, nor elimination of carbon, can go on, nor can the necessary increased supply of blood be conveyed to the acting muscles without injury.'

The proper amount of exercise requisite for health is difficult to determine, in consequence of the varied constitutions of individuals. It may, however, be accepted that whilst in youth the great spirit of emulation tends to an overstrain of mind or body, so, as life advances, one or other or both are liable to be allowed to pass into a state of unhealthy inactivity.

Since the more general practice of gymnastics in this country, and the stimulus that has been given to aquatic exercises by our University competitions, great attention has been drawn to the effect of bodily exercise on health, and more especially with regard to the heart and lungs, these being the organs upon which its influence is most immediately exerted.

Prolonged and Excessive Exercise.—Of all exercises, rowing is the one which is generally accepted as the best variety to select, if we are to endeavour by a consideration of its influence upon those who practise it to form an estimate of the effect of a continuous strain on the circulation and respiration; yet the difficulty of procuring trustworthy evidence on such a subject is extreme. Dr. Morgan, in his *University Oars*, by collecting the various experiences of nearly all the men who rowed in the University races from 1829 to 1869, has obtained about the most accurate testimony available in regard to one aspect of the subject. These men are unanimous in their belief that they experienced no injury from the great strain they underwent in their youth. But it must be borne in mind that they were the picked athletes of their colleges, men with large frames and full chests, typical specimens of health, capable of undergoing very prolonged exertion with but passing fatigue, and to whom no permanent injury could be anticipated, after careful training, from an exceptional display of strength. Such evidence affords no clue to the effect of the strain imposed on the heart by the two hundred or more of each University, who annually use the utmost exertion to belong to the chosen few, and many of whom, unguided in their violent efforts to achieve success, have in after-life to pay the penalty of allowing mere feeling or the spirit of emulation to overrule their reason.

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Exercise under Unnatural Conditions.—But it is not only the case that exercise which is excessive or too prolonged proves highly deleterious; even a moderate amount of exercise under unnatural conditions may prove equally harmful. Thus the young soldier of light frame, with irritable palpitating heart, who has broken down in his preliminary training, is a marked and good example of the early injurious effect of overstrain of the heart, under the impediment caused by tight clothing and accoutrements to the free expansion of his chest. When at rest he feels perfectly well, and has little or no sensation of throbbing in his chest. So soon, however, as he puts on his tunic and accoutrements, and begins his drill, throbbing occurs with more or less violence, accompanied with a feeling of oppression, and with difficulty of breathing, and this being followed by a sensation of faintness, sickness, or dizziness, he has to fall out of the ranks. At first the condition of the heart is one purely of functional disturbance, which, though rendering him unfit for the duties of a soldier, does not interfere with his gaining his livelihood as a civilian.

This functional derangement of the heart, which is readily shown by the dicrotism in the sphygmographic tracing of the radial pulse when auscultation can detect little or no change in the heart-sounds, is frequently found in those youths of delicate frame in our schools and colleges, who, 'breaking down' in attempting feats of strength or in the preliminary training, experience no ill-effects in the ordinary avocations of after-life from that overstrain of heart which, if neglected, would be apt to lead to graver forms of heart-disease.

Whether it be by sudden or prolonged violent exertion, by rowing, or by running, or by the many other severe exercises of the body entailed by labour or pleasure, there can be no doubt that the heart and lungs have at times an inordinate amount of strain forced upon them, which, in a state of health, or under favourable circumstances, they may reasonably be expected to bear with no more injury than temporary distress, and that this capability to bear strain is greatly enhanced by careful training.

It is customary for the healthy boy, however, owing to the character of his amusements, always to be in training, so far as his body is concerned, and with very little supervision he ought to suffer no harm from sudden and exceptional strains. But it is very different with men who have settled down into the real business of life, who, during their nominal periods of rest from their daily labours, undertake violent exercises without

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